

American Cinematographer

ASC Magazine

November 1928

Vol. IX No. 8

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American Cinematographer

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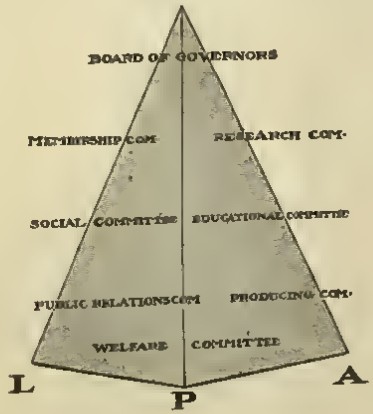
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EDITORIAL--The Voice of the A. S. C.

OUR EIGHTH BOW

THE AMERICAN CINEMATOGRAPHER is eight years old with this issue. On Navember 1, 1920, whet is now the A.S.C. megazine was horn as e simple folio weekly newspeper of faur pages, page size 11x16.

The little paper hecome popular at ance and while it was intended to he only a house organ for the A.S.C. and for lacel circulation only, outsiders soon hegen to snhscribe for it and edvertisers hegan toinquire ehout spece.

The Board of Governors tahing natice of these things and, upan recommendation of the editor, decided to chenge the publication into megazine farm and THE AMERICAN CINEMATOGRAPHER hecome a fortnightly megazine of sixteen peges an Octoher 1, 1921.

This persistad until April, 1923, when the megazine mede its eppearance as a monthly publication af thirty-four pages end, as such, it has remained to this dete without missing an issue.

In some weys this periadical is unique in the publication warld, end some af its claims to the unusual are here noted:

It is the only periodicel of magezine steture published WITHIN the motion picture industry.

In eight years it has grawn from a "throw awey" house argan to the stature of en Internetianal magazine.

It is the anly established periodical awned and published hy a group ar organization which is an integral dapartment of the motion picture industry.

With no invested capital to help it THE AMERICAN CINEMATOGRAPHER has steedily grawn in influence end excellence until it is now the recognized technicel journal of the cineme hoth in Americe and ebroad.

It is circulated in thirty-four foreign countries, the largest circuletion ehroad heing in England, France, Garmany, Japan, Austrelie end the Straits Settlements.

It is used as e work of reference in universities and schools heth here and abroad, end the demand far it hy educators in cinematography is increasing daily. In this connection an excerpt from a letter recently received from the University of Liverpool, England, is interesting:

"THE 'AMERICAN CINEMATOGRAPHER' IS TO MY MINO AN EXCEEOINGLY INTERESTING PUBLICATION, RENOEREO ALL THE MORE VALUABLE IN THIS COUNTRY OWING TO THE FACT THAT WE HAVE NO SIMILAR PUBLICATION. THE EXISTING TRAOE PAPERS ARE, AS YOU ARE PROBABLY AWARE, PUBLISHEO IN THE INTERESTS OF THE EXHIBITORS AND CONSEQUENTLY AUTHORITATIVE TECHNICAL ARTICLES ARE FEW ANO FAR BETWEEN."


LOYALTY PROGRESS ART THE AMERICAN DISTINCTION BASED ON MERIT

CINEMATOGRAPHER

THE MEN WHO MAKE MOTION PICTURES

VOL. 7 NO. 1 LOS ANGELES, CALIFORNIA, NOVEMBER 1 1928 TEN CENTS A COPY

THE CAMERAMAN

Its circulation, though modest, compered with the fan megezines, reaches the important people in the production departments of the cineme and ellied industries and thus enahles THE AMERICAN CINEMATOGRAPHER to take rank as a husiness producer entirely out of proportion to its circulation. Its advertisers are the hest firms in the industry and they have been represented in this megezine ever since its columns were opened to edvertising.

The A. S. C. megezine hes never wielded its influence in any destructive mannar against either individuals ar organization. It has no axes to grind end no politics to pley. Ever and always it has stood for leyelty, progress end ert in the industry and hy this attitude it has wan the respect of all.

It "plays" no favorites and never in the eight yeers af its existence has it heen used to further the selfish ends af any officer ar memher within tha A.S.C., nor eny pawer outside the Society. And, to pay e tribute to the man who have fostered its growth, its editor can testify that in no instance hes any such ettampt heen made.

THE AMERICAN CINEMATOGRAPHER, evar since it first hecame a magazine, has heen self sup-

(Continued on Page 20)

St. Paul to the Congo

By Chas. E. Bell

Vice-President, Ray-Bell Films, Inc.,
Saint Paul, Minnesota

In October 1927, I was asked to handle the photography of the O'Brien-Burbridge expedition to Africa. Having spent the last twenty years making motion pictures all over the United States and Canada, I was glad of the opportunity to photograph and see a new country, and accepted.

I had heard a great deal about the difficulties of exposing and keeping photographic material in a tropical country and was, therefore, asked to take along a developing outfit for the motion picture negative. As one



usually has enough to look out for in getting his pictures I did not relish the idea of bothering with a portable (?) developing outfit.

Therefore, I left a few days ahead of the party and stopped in Rochester where, after consultation with George Blair and Hereford Cowling of the Eastman Company, I was assured it was not necessary to develop my negatives, and with proper precaution could bring all footage back with me, and then have it developed in our own laboratory some seven months later. Even after that length of time in as hot and moist a country as the Belgium Congo, I did not lose a foot of film due to climatic conditions.

The Eastman people packed my stock in a very thorough manner and a few details of this packing are interesting: The 200-foot rolls of negative were first wrapped in the usual black paper, and placed in the usual tin cans; then five of these cans were put into a larger tin can and hermetically sealed. This one-thousand-foot can was placed in a cardboard carton and four of these put into a special tin container and again hermetically sealed. This tin was placed in a light wooden box and another heavier wooden box followed with excelsior packed between the wooden boxes. The thirteen that we had of this size weighed fifty pounds each.

My photographic equipment consisted of an Akeley camera with two inch, six inch lenses, and a seventeen-inch telephoto; an Eyemo; a 4x5 Graflex with an eight-inch lens and a telephoto lens of seventeen-inch focal length. Developer was carried for the still negatives as it was advisable to develop them as shot; never leaving them undeveloped longer than two weeks. I took 30,000 feet of motion picture raw stock divided as follows:

12,000 feet Panchromatic.
10,000 feet Orthochromatic.
3,000 feet Super Speed.
5,000 feet 100-foot rolls for Eyemo (Ortho).
400 4x5 commercial ortho cut films.

We left New York the last of October for Paris where we outfitted; leaving there in November. We sailed 22 days before arriving at the mouth of the Congo River and disembarked at Matadi. Here we unloaded our five thousand pounds of baggage, and I got a good scare when one of our trunks slipped into the river. All of the trunks looked exactly alike, and I wondered if THAT TRUNK contained the telephoto lenses! Luckily, I found

later that it DID NOT, and we never did really find out what the trunk contained, as it soon sank out of sight in the waters of the Congo. Matadi has the reputation of being one of the hottest places in the world and, I believe, it was living up to its reputation when we arrived. I was thankful to get aboard a queer narrow-gauge railroad that took us up the river banks to Kinchasa. It was here we made up our "chop boxes," which are food supply boxes, and booked passage on a double-decked steamer for Stanleyville. The Congo River is a magnificent stream and I had opportunities for some fine shots and exposed about a thousand feet going up the river.

In 14 days we reached Stanleyville, where we made up our caravan for the interior. We secured two trucks and two passenger cars, which were Fords, as might be expected. With this outfit we toured on very good highways, and made our river crossings on ferries made up of barges. After several weeks of interesting travel through the Belgium Congo and passing through many native villages, I made a number of interesting native-life sequences. We then came to Wamba, the end of the motor highway, and here we gathered two hundred native porters for our first safari. It took two hundred to carry only a part of all our baggage that we had to take on this safari.

In transporting the photographic equipment I alone used some 25 black boys. We started our journey through the Ituri Forest, and in order to keep the "stragglers" moving some white people had to "follow-up" the marching line of two hundred as well as lead it. The Ituri Forest is very dense—difficult to obtain exposure without wide-open lens. Many times I looked up at those towering trees and could only see a very small patch of the blue sky above. I have seen great forests and trees in America but never beheld as marvelous growth of timber as that in the Ituri. Here is the home of the world's greatest beast—the African elephant. We spent day after day trailing these monstrous beasts without seeing —only hearing them a few hundred feet ahead of us; our scent enabling them to keep ahead of us. After a week trying to get a shot of a herd or even a big "tusker" with the Akeley, we gave it up for the time being. Later I did get some worthwhile scenes, using the Eyemo and working as fast as possible.

And it was here we met the "grown-up children," as I called them, the Pygmies. We staged and secured some splendid shots of their manners and customs. And we gave them a reward that was to them as good as gold to us—salt. How they liked it; and they thanked us greatly.

We left the Ituri Forest here and near the Ikebondos Country came upon one of the most perfect and beautiful African villages I saw on the whole trip. The Sultan here had some 200 wives, and he had them dance for us, as well as stage his own performance, and I had an opportunity for some unique and not-often photographed subjects. The Sultan's music was the original "jazz orchestra," I'm sure. We lingered here ten days and secured a lot of interesting material. Our safari continued on to the Aruwimi River, where we dismissed our porters.

Here we hired four dug-out (of huge trees) canoes, manned by forty paddlers each, and started a trip down the river; the rapids and tropical foliage along the shore made wonderful settings. Care in packing one's belongings had plenty of emphasis here one day as a near accident showed us. One of the canoes containing Miss O'Brien and Mrs. Flandreau capsized on rocks out in the middle of the river in the rapids. Luckily besides a good wetting of all on board and soaking of the clothing in several trunks, they escaped after frightening the rest of us for several minutes. And afterwards I was asked, "Oh, why didn't you make a picture of us!" My mind was far from that subject during those brief minutes of excitement!

Soon back at Stanleyville we picked up additional supplies and continued our trip up the Congo.

Leaving the Congo we then traveled east to Lake Tanganyika where we entered into British East Africa, the country renowned for its game. An entirely different race of people inhabit this country and are known as the Masai. The photographic conditions here are not at all like the Belgium Congo, which is dense jungle for the most part, but here open country prevails with intense heat and light conditions comprising the photographic problem. Thousands of various game can be seen in herds on the plains. One's difficulty here is to get the animals with proper background or setting, and if you are fortunate in getting the game at their waterholes, exceptional good shots can be made. Lions are numerous, and one day counted fifteen that crossed our trail. A few weeks here hunting and photographing and then to Nairobi, a city famous as a starting point of the big game country. From here we went by railroad to Mombasa; sailing for home from there.

What Is a Twin Dissolve?

Ex-President Dan B. Clark, A. S. C., announces the development of something new under the sun in the way of a dissolve.

It was during the shooting of the new Fox picture, "Husbands Are Liars," directed by Ray Cannon, that the new dissolve, named by Mr. Clark "the twin dissolve," was evolved by Clark in collaboration with Director Cannon.

There are some dream sequences in "Husbands Are Liars," and it was desired to get something unusual in the way of camera effects.

F. M. Sersen, the scenic artist, was called in to paint ten backgrounds of futuristic type, one of which is shown in the still herewith.



One of the futuristic backgrounds in "Husbands Are Liars." Left to right: Director Cannon, Artist Seraen, Cinematographer Dan B. Clark.

The backgrounds exactly suited the dream stuff, but how to make them come to life and change without going through the old process of dissolving in and out was the problem, for, according to the plans of Cannon and Clark the action was to be uninterrupted while the backgrounds came and went in a continuous succession.

After much experimenting the mechanics of the new idea were developed successfully and the Twin Dissolve has been artistically applied in Mr. Cannon's latest picture, in which Mr. Clark has also perfected what is known as the "Cannon shift," another very interesting camera effect.

Mr. Cannon and Mr. Clark have promised to dedicate the Twin Dissolve to the A. S. C. as soon as the picture is released and it will henceforth be known as the Clark-Cannon dissolve. Any member who may be interested in using it may see it in operation in "Husbands are Liars."

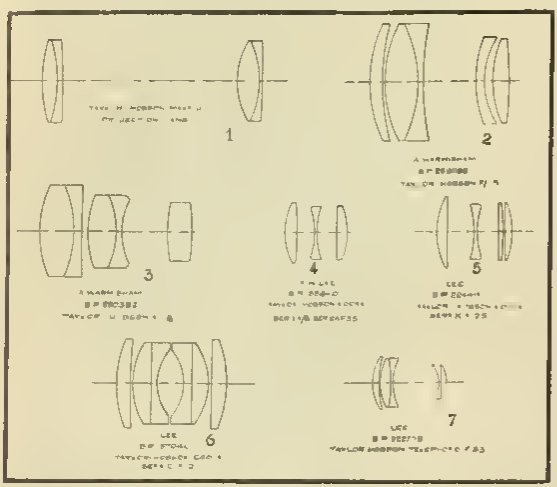
The new dissolve brings incandescent lights into practical use. The inventors claim it cannot be successfully achieved with any other kind of light.

The Modern Super-Speed Lens

By H. W. Lee, *B.A.*

(Taylor, Taylor & Hobson Research Department (Leicester, England).

The need for rapid lenses which would permit of short exposures with the slow sensitive material then available, was felt in the early days of photography. Prof. Petzval of Vienna, in 1840 designed the lens which bears his name. The aperture, F/3.5, was sufficient for the needs of the photographer then, and for some years opticians turned their attention to improvement in the field of the photographic lens. In 1893 came the anastigmat, including Dennis Taylor's Cooke Lens, consisting, in its final form, of three simple lenses. One of the forms was a portrait lens of aperture F/3.7. This was successively improved up to F/3 by its manufacturers, Taylor, Taylor & Hobson, and remained for many years the most rapid anastigmat on the market, the German opticians generally preferring the symmetrical type of lens in which each half consisted of three or four lenses cemented together, a form found to be favorable for field corrections but not for yielding a large aperture. In 1894 Dr. Rudolph, adapting the Gauss type of lens, invented the Planar having an aperture of F/3.3 and covering the large field of 50 degrees. From these three types, the Petzval, the Cooke and the Planar, have developed the modern extra-rapid lenses.

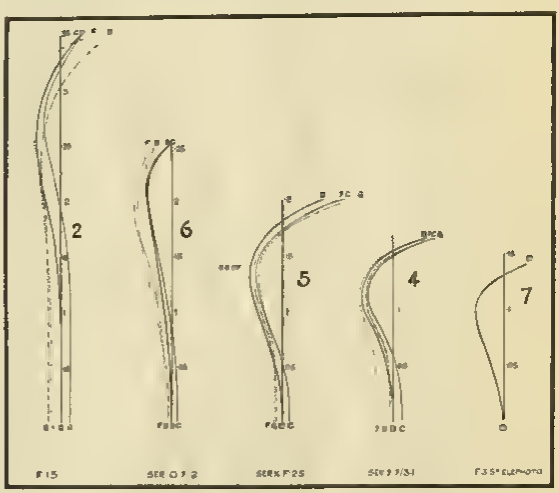


Returning now to the Petzval lens, consisting of a cemented doublet behind which and at some distance is placed an uncemented doublet, various improvements have taken place. A. Warmisham, of Taylor, Taylor & Hobson, had in B.P.* 180,949, increased the separation so as to obtain improved illumination of oblique pencils; and at the same time he used different glasses and cemented the back component, and was thus able to increase the aperture to F/2 (Fig. 1). This is the Taylor-Hobson "Maximum" Projection Lens, so named because it uses the maximum available aperture allowed by the projection lens tube and so passes the maximum amount of light.

* B.P. means British Patent.

A. Warmisham in B.P. 258,092 was able further to increase the aperture to F/1.5 (Fig. 2) by replacing one of the doublet lenses by a pair of meniscus lenses, one or both of which might be doublets. His success is illustrated by comparison with the best of the modified Petzval lenses shown in Von Rohr's Theorie u. Geschichte des Photographischen Objektivs (due to Steinheil), the curves for spherical abberation being shown. The Petzval lens in its various forms suffers from flare spots which makes it particularly objectionable in kinematography. A modification of A. Warmisham (B.P. 280,392) (Fig. 3) is free from that defect, the negative component being removed from close to the back to close to the front, and made a cemented doublet.

The Petzval type is thus taking on a new lease of life,



and still has its uses when the angular extent of field required is not great. Where, however, the field is not limited to 10 degrees or so, the anastigmat must be employed. The Cooke lens itself had been improved and its aperture extended, as a comparison between the aberration curves of the earliest and one of the latest forms patented by H. W. Lee, as B.P. 155,640 will show. This is manufactured as the Taylor-Hobson Cooke Lens, Ser. I or Ser. IIA (Fig. 4). Greater improvement can be obtained by dividing one of the elements, by which the aberration of that element is reduced. What usually limits the aperture at which a lens can be used is that the correcting aberration of the negative lens has a preponderating influence at the extreme aperture, due to the large angles of refraction which occur there. This overcorrection can be reduced and the aperture increased in two ways:

(1) By reducing the aberration of single elements by dividing them, or

(2) introducing compensation abberations, usually by means of deep cemented surfaces.

An example of the first method is seen in the form patented by H. W. Lee of Taylor, Taylor & Hobson in B.P. 224,429, in which the back lens is replaced by two simple lenses yielding an aperture of F/2.5. This is listed as Taylor-Hobson Cooke Lens Ser. X f/2.5, and Ser. XIII f/2.9 (Fig. 5). It is particularly suitable for use with reflex cameras on account of its lightness, arising from its simple construction. Its aperture is found to be as great as the reflex will usually accommodate.

The last form of large aperture lens has been developed from the Gauss form by way of the Planar. In fact a lens of this type was the first to obtain wide use as an

F/2 lens, patented by H. W. Lee in B. P. 157,490 and manufactured by Taylor, Taylor & Hobson as Ser. O (Fig. 6), and it remains the lens with the largest field available at that aperture. A large field is not usually associated with extreme aperture, but is of distinct advantage because a shorter focus lens can be fitted to a camera, thus reducing bulk and weight. E.g., a lens of of 1¾ inch focus will cover the standard kinematograph film, giving wide angle pictures without sacrifice of aperture. The aperture of this lens can be pushed still further by replacing the negative doublets by triplets (H. W. Lee, patent applied for 1928).

However, the wide angle lens is not always necessary, and at the same time, when the field exceeds about 10 degrees, something better than the Petzval type of lens is required. This is particularly noticeable in back projection work where the available "throw" is small, requiring lenses having a field of from 20 degrees to 40 degrees. An "intermediate" lens of this type having the good definition associated with the Petzval lens over a medium angle field of 40 degrees has recently been designed by H. W. Lee (patent applied for) and put on the market by Taylor, Taylor & Hobson, as the "Magnum" projection lens, f/1.8. Essentially it is constructed as the old Petzval lens of two collective components, but here one of the components is a Cooke lens anastigmat triplet which flattens out the field. This is combined with a cemented achromatic doublet which halves the focus and therefore doubles the aperture, which reaches to f/1.8.

Finally the telephoto lens has not been neglected in the progress to greater speed, and already lenses of aperture F/3.3 are on the market, manufactured by Taylor, Taylor & Hobson. In B.P. 222,709 (H. W. Lee) this is accomplished by replacing the ordinary front doublet of the telephoto lens by two positive menisci (one of them a doublet) (Fig. 7). Thus the advantages of the telephoto ("close-ups" without moving the camera) are available to the kinematographer.

A few years ago it would have been said that lenses having apertures of F/2 and F/1.5 were useless—they have not sufficient depth of focus, and would require too much skill in use; and there may be some who think so still. The experience of the last few years emphatically contradicts this view. Kinematography and especially the phenomenal rise of amateur kinematography, have led to the production of thousands of lenses of apertures F/2.5 to F/1.5, giving as good definition as the former F/4.5 lenses, so that they are admirably suited for kinematography where the small picture has to suffer great enlargement. The short focus lens has abolished the bogey of want of depth of focus.

Mass production has brought the price of large aperture lenses down so that they can be fitted to the amateur kine camera; accurately made focusing scales, view finders, range finders and other gadgets allow of accurate focussing.

So much for present achievement. Is it possible to look for any further startling advances in the future? It is obvious that the cult of speed has led to greater complexity of structure, which means high price. Still greater speeds will mean more expensive lenses—not a serious matter to the professional perhaps, but limiting the field among amateurs. The working of deformed spherical surfaces, the discovery of new minerals, of artificial crystals, or of glass of highly desirable optical properties may be expected to lead to improvement of lenses—one direction in which advance may be looked for is in improved color correction for use with panchromatic emulsion, which is being increasingly used (in other words the invention of "apo-chromatic" speed lenses). Some work has already been done in this direction.

THE AMERICAN CINEMATOGRAPHER congratulates Herford Tynes Cowling, A. S. C. upon his elevation to the Board of Governors of the S.M.P.E. Mr. Cowling is the first cinematographer to serve on the Board and he is certain to give a good account of himself.

Hal Mohr, A.S.C., has just signed a two years' contract with Universal. He is now in New York on a brief vacation.

Our A. S. C. Outposts

Fred Parrish, A. S. C., whose home is in Colorado Springs, Colorado, was official cinematographer attached to the Cadle-Cameron American Expedition which has just finished a trip through the famous Kalahari Desert, in Africa, one of the few remaining unexplored spots on the globe.

The expedition went into the desert at Johannesburg and came out at Victoria Falls and Mr. Parrish will return to America with some of the most interesting and original film ever shot.

The last heard of the expedition was in a copyrighted special cable from Johannesburg to the New York Times,



FRED PARRISH, A. S. C.

of date October 15th, as follows:

(Exclusive.—Bushmen who live in conditions exactly like those of the early Stone Age have been discovered in the Kalahari Desert by Dr. Cadle, head of the Cadle-Cameron expedition. Cadle is returning to America convinced that Kalahari is the real cradle of the human race.

"On the whole they have no implements or weapons of iron or steel," he said. "Their arrows are tipped with bone or ivory and they use stone knives. They have absolutely no social organization. They live in communities of two or three families and exist entirely by hunting

"Among them no one has any authority over another. Each man is law unto himself. They are nomadic completely in their way of life—in fact, their code of life is dictated by the game they hunt. They contest with vultures the remains of game killed by lions, and bury their sick before they die."

Dr. Cadle intends to return with a larger expedition next year.

Mr. J. I. Crabtree, Chairman of the Committee on Papers and Public Relations of the S.M.P.E, writes that the September meeting of the Society at Lake Placid, New York, was probably the most important, as well as interesting, in the history of the S.M.P.E. Mr. Crabtree has the most difficult duty in connection with these semi-annual meetings and his skill and ability in handling the important documents read at the meetings has won the approbation and applause not only of every member, but of all who have to do these transactions.

President John W. Boyle, A.S.C., has just signed a contract with Mack Sennett and is already shooting sound comedies for the King of Komedies.

Ground Noise

A Study of Ground Noise in the Reproduction of Sound by Photographic Methods

By Otto Sandvik

*Communication No 374 from the Kodak Research Laboratories

Ground noise is a term ordinarily used to designate extraneous sounds which occur on a photographic sound record, or more explicitly, noises which are present on a film that either contains no silver deposit or else has a silver deposit of uniform optical density. The purpose of this paper is to point out some causes of these noises and to show how the noise level increases with repeated runs of the film through the projector.

Some of the earlier workers were inclined to believe that the noise was due to optical inhomogeneity in the film base itself. In order to investigate the validity of this connection a series of experiments was carried out. In these experiments, several kinds of film base besides the standard motion picture film were investigated. One of these experiments, and the only one which will be considered here, was to run the clean film through the sound reproducer in the usual manner. The gain or the volume control of the amplifier was advanced until a barely perceptible noise, caused by the moving film, was heard. This method is rather qualitative in nature; but has the advantages of directness and similarity to conditions which obtain in practice.

The results obtained by several observers showed that there was very little difference in the noise level of different kinds of film base; and moreover, that, with a gain setting as normally used for a sound record, the ground noise was imperceptible.

The amount of noise, however, was increased considerably by running the film through the projector a few times, and was found to be enhanced greatly by handling with the bare fingers, by impressing even minute scratches, or by blowing dust particles into the projector against the film while it was running through.

The next step was to determine how much, if any, the noise level was increased by the several steps involved in manufacturing the film, and the ultimate processes of developing, fixing, washing and drying.

The method followed in this investigation was to run the film sample under consideration through a standard sound reproducer, and measure with a thermocouple and millivoltmeter the power output of the amplifier. If the film is optically homogeneous; the power output is either zero or some constant value. If, however, the film is not homogeneous, the amount of light following on the photo-electric cell varies and the power output is a function of these variations in the light intensity. Moreover, the loudness of the noise is a function of power delivered by the amplifier into a loud speaker. It is quite beyond the scope of this paper to consider in detail the relation which exists between intensity of the sound and loudness, or the stimulus and the sensation. It is not, however, essential for the present to consider this relation since we are interested only in the relative amount of noise which occurs under various conditions and this is indicated fairly well by the relative amounts of electrical power energy which are caused by the film running through the sound reproducer.

The method of making the measurements was to read voltmeter deflections at constant intervals and take the mean of a large number of these readings to represent the noise level of the film in question. A set of such observations for film at various stages of manufacture and processing are shown in Fig. 1. It is seen from these that the noise level is the same for plain and substrated base. That is, no dirt or other factors giving rise to optical non-homogeneity are introduced by substrating the base.

Now when the film base is emulsion-coated and put through the regular process of fixing and washing, or developing, fixing and washing, the level of the noise intensity is found to be somewhat increased. The question naturally arises: Is the gain in noise due to the emulsion, or it is due to the processing? To answer this question two experiments were carried out. One was to find out the difference in the noise level introduced on two pieces of the same film in wiping the film after washing by machine or by hand. The results obtained showed that the noise level on the film which had received careful manual wiping was less than half that which had been wiped by machine. These results clearly indicate the importance of very careful handling during processing film used for sound recording. The second experiment was to take a piece of film base, substrated but not emulsion-coated, and run it through the regular process of developing, fixing, washing and drying. The results obtained showed that noise level had been increased considerably above that of another sample of the same piece of film which had not been processed, and, furthermore, that it was comparable in magnitude to the noise level on a film emulsion-coated and processed. It may be concluded, therefore, that there is no appreciable increase in the noise level at the various stages of manufacture. There is, however, a considerable increase in the noise level during the process of developing, fixing, washing and drying even when these operations are carried out by a skilled worker and with the utmost care.

It is of interest to note that film fixed without development is noiser than film which has been developed so as to add a small density (about 0.1), due to a certain amount of fog present; and that the film which has received a uniform exposure so as to increase this density to about 0.25 has still less noise. This can be accounted for on the basis that a certain amount of dirt, speaking in a broad sense, has been introduced, and that the presence of this dirt causes a larger variation in the light incident on the photo-electric cell on the clear film than on one of which the transmission has been reduced somewhat by a uniform silver deposit.

It seemed to be of interest to determine how the noise would grow by repeatedly running the film through the projector. To investigate this point four samples of film were prepared, two of which were developed without exposure, the other two being flashed and developed with a resulting uniform density of about 0.3. These films were then run repeatedly through a standard projector with sound-reproducing attachment, the film being rewound after each run. The same method of obtaining an indication of the noise level as described above was used; i. e., a thermocouple and millivoltmeter placed in the output circuit of the amplifier, and taking the mean value of the power output for a larger number of readings obtained at constant intervals of time.

These results are shown in Figs. 2 to 5, inclusive, where the power output is represented by the ordinates, and number of times run through the projector are plotted along the abscissa. Curves 2 and 3 represent the two films developed without exposure and Curves 4 and 5 the two which were exposed and developed. It is seen from these curves that after the first few runs, the increase in power or the intensity of the sound is practically uniform with the number of times run. The increase in the loudness or the auditory sensation, however, would be less rapid since the sensation is not directly proportional to the stimulus.[1] This increase in the sound intensity is undoubtedly due to accumulation of dirt and scratches on the film and would probably con-

1. Harvey Fletcher Physical Measurements of Audition and Their Bearing on the Theory of Hearing. Bell System Tech Jour. 1-2: 1922-23 145

tinue to grow more or less linearly until a saturation value, so to speak, would be reached.

It is interesting to note that ths rate of growth of the noisa intensity is more rapid for the two film samples having the lesser density. This, as pointed out above, can be accounted for on the basis that tbe percentage change in amount of light incident on the photo-electric cell produced by a given amount of optical inhomogensity in the film is decreassd as the total transmission of the film is decreased.

It may be pointed out that a sound having the vibration frequency equal to the number of perforations passing the slit per second, usually called sprocket noise, is not always due either to irregularity in the motion or of the film or tbe edge of the perforation passing over the slit, but is frequently caused by a small tear or a strain at one corner of the perforation. It may also be caused by a periodic variation in density along the perforation track, tbat is, an area of higher density along the perforations and one of lesser density between the perforations. These areas are of sufficient size to extend into tbe sound track. This variation in density is probably caused by insufficient agitation of the developer during development of the film.

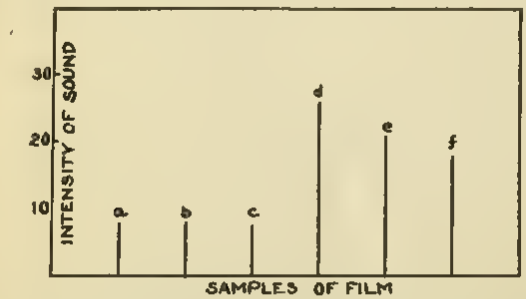
For a discussion of the relation between sound intensity and the loudness the reader again is referred to the paper by Harvey Fletcher which, in addition to the completeness of the paper itself, contains a very excellent bibliography of the literature on the subject.

Summary

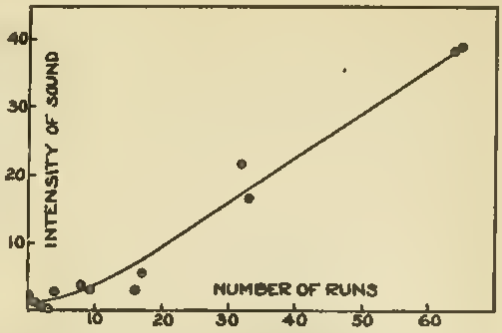
The results obtained show that the amount of noise present in clean film base, with amplifier operated at a normal gain, is imperceptible.

There is no appreciabls increase in the noise level introduced at the various stages of manufacture, but a considerable increase in tbe ground noise is introduced during the process of development, fixing, washing and drying, even when these operations are carried out with the utmost care by a skilled worker. This increase in noise is very probably due chiefly to dirt and abrasions received by the films during the process.

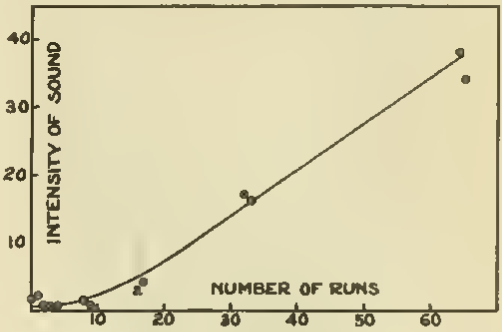
The growth of the noise level by repeatedly running the film through the projector, after the first few times, increases linearly with the number of times run. This increase in noise level is undoubtedly due to dirt, dust and scratches which accumulate on the film at a more or less constant rate until a saturation value, so to speak, is reacbed.



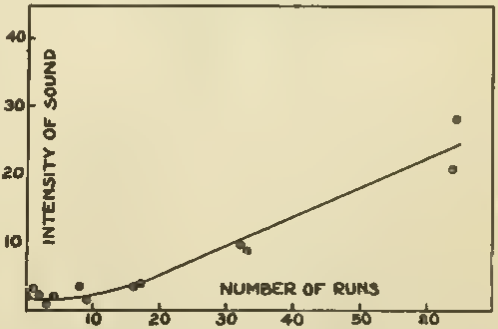
1. The graph indicates the noisa present in samples of film at various stages of manufactura and processing: (a) Without substratum; (b) substratum on one side; (c) substratum on botb sides; (d) emulsion-coated, fixed, washed and dried; (e) emulsion-coated, developed, fixed, washed and dried — density about 0.1; (f) emulsion-coated, exposed, developed, fixed, wasbed and dried — density about 0.3.



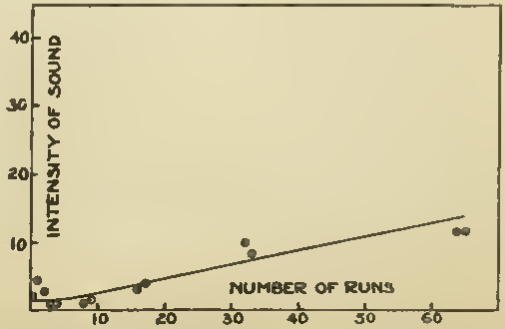
2. Curve showing the increase in ground noise, on a film having a uniform density of 0.1, by repeatedly running it through the projector.



3. Same as Fig. 2.



4. Curvs showing the increase in ground noise, on a film baving a uniform density of 0.3, by repeatedly running it through the projector.



5. Same as Fig. 4.

Applicability of Stereoscopy To Motion Pictures

By Lewis W. Physioc

Independent Producer of Process Shots and Special Effects, Tec Art Studios, 5380 Melrose Ave., Hollywood, Calif

The progress being made in some of the color processes and the revival of interest in the talking pictures, especially those devoted to sound photography, have elicited the statement from many sources that "the next step forward is stereoscopic motion pictures," which will complete the system of reproducing, artifically, all of the elements of dramatic art, i. e., speech, action, form, color and solidity.

This discussion is not intended as an exposition of the theory of stereoscopy because the subject is familiar to most of the scientific staff of the picture business. It has been suggested, however, that this society might well go on record in establishing a few facts for the benefit of those who might hold too lightly a serious problem, or who still cherish the idea of some system for producing stereoscopic motion pictures, that might be acceptable to the public. Nor is it our wish to deny the possibility of what we call a practical solution of this problem, for the mind of man has achieved such wonderful things, especially in the last fifty years, that the student hesitates to place a limit upon its accomplishments.



Lewis W. Physioc

We observe a growing confidence in the endorsement, by this body, of any idea designed to improve our art, and it is for this reason that we call attention to various experiments that have been misunderstood or misrepresented.

The study of stereoscopy antedates, by many years, even the art of photography. Leonardo da Vinci selected from the common observation of this phenomenon two well defined elements in the art of picture making: those of stereoscopy and perspective. Theretofore, these two subjects were merely matters of curious interest to the more observant minds, but da Vinci made a deep study of them and deduced them to rules and laws sufficiently well grounded to place them among the arts and sciences. Also important was his observation of the effect of pseudo stereoscopy, i. e., in viewing a picture with one eye, placing the eye in, as nearly as possible, the actual point of sight. This discovery was so important that at the present day artists delight in viewing well rounded pictures or photographs from this "point of sight." Errors of draughtsmanship, camera set-ups and the focal length of lenses are often traceable to a lack of appreciation of this simple but important expedient.

The word Stereoscopy is derived from the Greek, Stereos, meaning solidity and relief, but the following classification of the numerous elements associated with the phenomenon suggests its inadequacy.

First. Perspective: the apparent diminishing of the size of objects, the converging of parallel lines to the so-called "vanishing point." This branch of art has furnished such a beautiful application of mathematics that infallible calculations may be made of the distance of objects from the point of sight, their relative distance from each other and their dimensions.

Second. Common experience: dating from the conscious period of babyhood and by which we measure distances by judging the juxtaposition of objects and the overlapping of each other in the field of vision. This is one of the earliest provisions of nature for self-preservation, by enabling us to determine the nearness or remoteness of elements of danger, and also in the performance of manual labor.

Third. The physiological construction of the eye: a complicated system of mechanics that excites a reverence for the provisions of nature.

Fourth. The mental reaction to this physiological stimulus: a subject that awes the most learned.

These various elements combine to produce the phenomenon, stereoscopy, which, in turn, is divided into several degrees.

A. Complete Stereoscopy: the full effects of binocular vision among individuals possessed of a high degree of development of the physiological requirements and a perfect mental reaction.

B. Pseudo Stereoscopy: the limits of monocular vision, or even individual deficiency in binocular vision, and various effects produced in monolens pictures.

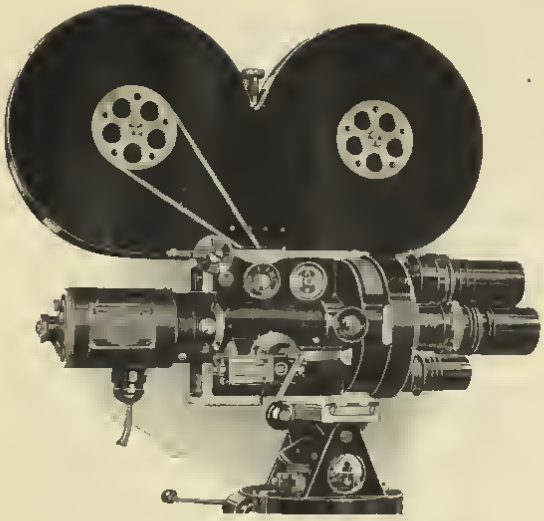
C. Direct Stereoscopy: by which we measure the dimensions of a single object, its form, etc., independent of its surroundings.

D. Indirect Stereoscopy: by which we determine the dimensions, forms and relative distances by comparison with their surroundings. This is due to the unconscious appreciation of associated object outside of the so-called "yellow spot," when focusing on a given field. Indeed, it is questionable whether there should be such a classification as direct stereoscopy, for the oscillation of the orb is such an involuntary, independent agency, and the scope of the yellow spot is so great that in viewing even a tiny spot against an absolutely neutral background it is difficult to maintain a fixed point of sight. This directness is supposed to be maintained in proportion as we limit the field of vision, but the gaze is very obstinate when an effort is made to keep it on so small a point as a pencil dot. Even when studying a sphere against a black background, the supposedly ideal example of direct vision, the gaze shifts from one area of the surface to another and keeps up a continual process of comparison by indirection.

A review of this very limited consideration of the elements of the subject will demonstrate the problem confronting the experimentor in this branch of motion pictures.

Some may seek to discount our pessimism by reciting the fact that they have witnessed demonstrations of stereoscopic motion pictures. This is true, and in reviewing the various methods by which those pictures were made we consider the obvious mechanical and mathematical propositions under which experimentors have agreed for years. We refer to the necessity of the picture corresponding to the vision of the right eye being neutralized, while the left functions, by means of shutters or spectacles, each eye being furnished with mediums of complementary colors; both expedients depending upon the persistence of vision in associating the two images in the brain, and in lieu of the prisms or reflectors of long established methods.

These pictures have been interesting but costly experiments and of no commercial value, for several reasons. First, because they depended upon the co-operation of the audience, and the public is a cruel, impatient patron or partner when it is expected to share the difficulties of an enterprise. Secondly, they represent a very poor patent protection. Most of the patents granted on devices for making stereoscopic motion pictures show very little originality and nearly all embody the first principles of the early days, even of the times when drawings were viewed in simple instruments like Elliot's stereoscope. The only unique device shown is one based on the



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For more than five years Bell & Howell have been experimenting, refining, perfecting—to eliminate *sound* in the operation of the universally used B. & H. Pioneer Standard Professional Camera.

Engineering and manufacturing reforms of unusual nature resulting from these experiments have made Bell & Howell Sound Recording Cameras *silent*—so silent that some studios *do not use a soundproof booth* in operating them for sound recording purposes.

Bell & Howell were *first* to make cameras for sound recording purposes. And so eminently successful have been the results that the following leaders in the development and production of Talking Pictures use Bell & Howell Cameras almost exclusively:

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General Electric Company
Metro-Goldwyn-Mayer
Paramount-Famous-Lasky
Powers Cinephone Equipment Corporation
R. C. A. Photophone, Inc.
Universal Pictures Corporation
Western Electric Co.
Westinghouse Electric & Manufacturing Co.

Members of the American Society of Cinematographers and others throughout the world, interested in the sound recording phase of motion picture making, will be interested in having these facts. Write us for detailed descriptions, technical information or prices on B. & H. equipment for all professional purposes.



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oscillation of the eye and produces only pseudo stereoscopy.

Many other experiments have been suggested by these pseudo effects, such as the oscillation of the eye in monocular vision or the rapid and even change of parallax, observed in pictures taken from an areoplane circling over tall buildings or from a boat moving along a winding stream, or from da Vinci's effect of viewing a picture from the proper point of sight. These effects have been attempted, in motion pictures, by placing the camera on a platform moving in an arc, the radius extending somewhere back of the set, by which means the foreground objects are continually measured against those in the background. Other experiments provided queer lenses placed in front of the main objective or by reflecting the image into the camera, special screens that insist on one person in the audience sitting in the proper place, all of which are worthless propositions. Through ignorance of the subject, there have been misrepresentations of millions of dollars having been spent in perfecting a system of stereoscopic motion pictures, and it is due those concerned in that project to state that we do not believe there has been any claim of true stereoscopy in a wide range picture taken with a single lens or without the aid of optical devices for the observer. The name ,"Natural Vision," has probably been erroneously used in designating a monolens picture covering an angle more nearly equal to the range of the human eye than that of the standard motion picture. Even this system comes within the realm of artistic judgment as to how much of a subject should be presented, to furnish excellent composition, for there is no pictorial value in scattering our vision over a tremendous area.

It is interesting to observe that the difficulty lies not in the taking of stereoscopic motion pictures but that the real problem is in projecting them, which brings us to a consideration of the much disputed points suggested in sections three and four, i. e., the psycho-physiological elements.

Outside of the body, and even as far as the two retinae, we have a satisfactory explanation of the phenomenon of stereoscopy, arrived at by deductive reasoning, aided by many branches of mechanics and mathematics; but when we leave the retinae we are to suppose a sort of psycho-physiological stereoscope set up in the brain, which at present is conveniently explained by assuming that the optic nerve transfers the retinal stimulus to the brain. We are confronted with the proposition of two flat images, similar to those on the ground-glass of an ordinary camera, falling upon the retinae and associated in some manner in the optic thalami, then transmitted through the optic radiation to the visual centres and other parts directly connected with the perception of this effect, particularly the memory chambers. (It has been shown that people not endowed with a well developed perception of stereoscopy have faulty memory.)

Up to the present time, the functions of the rods and cones and the Muller fibres of the eye and the optic tract, and the neurons connecting the retina to the brain, have been imperfectly understood. Delmar A. Whitson advances a theory that insinuates the subject into the ever-broadening realm of radio, by observing, in the construction and association of the rods and cones, a system that suggests an electronic relation, to form a sort of receiving set. According to physical laws, any instrument capable of receiving a wave also has the power of emission. Curiously enough, this theory appears to be substantiated by a series of experiments conducted by Dr. Charles Russ, by which he caused a delicately balanced electrical instrument to respond, actively, to the direct glance of the eye. Whitson's theory provides the assumption that the effect of vision is the result of a heterodyne action produced by the waves of the eye challenging those directed towards the eye. It has been established that in both sound and radio waves the heterodyne sets up a long beat note and that this beat wave may be responsible for the effect of vision. This does not seem to conflict with the accepted theory of light for we know that the eye is not constructed to receive the full rays of the spectrum. This theory might suggest that stereoscopy is the result of a very complex system of radiation from near and remote planes, limited in monocular vision and multiplied in binocular vision, and, in fact, the more complex the radiation, the more pronounced the effect of stereoscopy. It might also agree with the observation that perception of stereoscopy varies in individuals, due to the individual pathological condition and arrangement of the rods and cones. And, further, the idea of the eye emitting a wave agrees with the simplest explanation of the operation of the brain, "which is, in its highest activity, the organ of consciousness or mind, and its general function is that of furnishing the most complex and extensive outgoing stimulation of muscles and other active tissues as a response, more or less immediate, to the most complex and extensive incoming sensory stimulation."

The psycho-physiological consideration has so engrossed some stereo enthusiasts that it has been hinted that some progress has been made in attacking the problem from this angle. But, unfortunately, we have been furnished no details by which we may judge the merits of such a conception.

However, the more conservative students reflect the attitude of the aforementioned Dr. Russ, "supremely skeptical of any matters that do not lie within the scope of material proof, to be shown by touch, sight and measurement."

This present consideration revolves around the so-called pseudo effect, which has puzzled so many observers, and we revert to it as a concluding idea. As to the da Vinci effect, of viewing a picture with one eye, we believe that this is merely a matter of psychosis, in finding a perfect adjustment of the perspective "point of sight;" but we contend that there is no such effect as pseudo stereoscopy as regards vision, and that even in monocular vision, the effect is complete but is limited to the degree of parallax to which the single eye is capable of producing; and that the effect is enhanced or multiplied, in the use of both eyes by obtusing the triangulation. In viewing, with one eye, a group of small objects at very close range, we experience a perfect sense of third dimensional displacement, and that the effect is reduced as we remove the group from the eye. Likewise, in viewing objects at a great distance with both eyes, the field flattens in proportion to the distance of the objects from the eye. In single eye vision, at very close range, the principle that every point of a lens is an individual lens, with the iris providing a minute inter-pupilary distance, a very complex system of triangulation is set up. However, this is only noticeable at an extremely short focus, and it is probably for this reason that it has been overlooked as an important factor in the study of stereoscopy.

In the present subject, the field of physics is so greatly influenced by the physiological consideration that it is almost impossible to deduce it to principles or rules, and that an attempt to do so merely becomes a further elaboration. As briefly as possible, therefore, we define stereoscopy as photo-triangulation registered in the brain through the medium of the optic nerves. The spread of the image on the retina forming the base of the triangle and the diameter of the iris forming the numerous points of parallax and the degree of the effect varying with the focal length and the distance of the objects.

The rods and cones of the eyes are supposed to function dextrally and sinistrally and that the simultaneous registration of their activity produces the highest degree of stereoscopy, but it is also believed that the optic nerve system is so complicated and sympathetic that even in a one-eye exposure a certain number of the rods and cones effect a cross nerve stimulus to the opposite set of centres, especially near the periphery of the retina, which permits of a considerable degree of photo-triangulation in the single eye. This cross nerve effect is feeble and limited, in individuals, to the degree of this peripherical stimulus. It must be understood that this effect is observed at very close range and with the aid of an auxiliary lens to help adjust the focus, for although the eye contains an adjustable lens it has its limits, even in extremely myopic vision.

In conclusion, we can only center our hopes in the fact that nature generously provides many means to an end, that necessity frequently solves her problems. Public demand prodding a bright research mind, with unlimited

(*Concluded on Page 14*)

A Year in the Air

E. Burton Steene, A. S. C., is just rounding out a full year of Akeley Camera sequences for "Hell's Angels," the great epic of the airways in production by Caddo for release through United Artists, direction of Howard Hughes.

During all this year Mr. Steene was the only Akeley cinematographer on the aerial sequences save for two weeks when illness compelled a brief rest, which is the world's record for continuous Akeley service in motion picture production.

Mr. Steene is now on location in Oakland, whence be announces that the air shots on the great picture will be finished by the middle of November so that he expects to be available for engagements about that time. He writes that he never felt better and the accompanying picture certainly bears out his statement.



E. Burton Steene, A.S.C., at His Akeley Ready for Flight

"Hell's Angels" is rated to cost $2,000,000, and the producers claim its air sequences are the most remarkable in the history of motion picture aviation.

Harry Perry, A. S. C., in charge of photography on the production since it started, has had at times fifteen to thirty-five planes in the airway battle formations, and Mr. Steene, with his pilot, Mr. Frank Tomick, have always been in the thick of it, Mr. Tomick being one of the most skillful camera-ship pilots in the industry.

Fifty-two weeks of battling in the upper air, poised precariously with a camera and in the thick of strife that is everything war has to offer, except bloodshed and death, is a feat unequalled in cinema production, and Mr. Steene is to be congratulated upon his great record of which the A. S. C. is proud.

Saved from the Deep

Perry Evans, A. S. C., veteran aerial cinematographer who has recently done some work for the Eastman Kodak Company in conjunction with Herford Tynes Cowling, A. S. C., says:

"I don't believe it is possible to be so hardened that you can't be thrilled. We were up in San Francisco shooting some aerial scenes. The aeroplane chosen for the job proved to be an old army ship with a new coat of paint. The construction of this ship necessitated that I sit in the rear cockpit, which contained all of the gauges and instruments; so it left the pilot to manoeuver the plane somewhat blindly, as it were.

"Well, after looking the old tub over we took off to photograph the bay and the harbor. One of a series of shots was the approach to the Golden Gate as it might appear from the top of a huge ship inbound. We had cruised out to sea about seven miles and were about to turn around when I happened to look at the gasoline gauge. The figures showed exactly three-quarters of a gallon! Think of it, seven miles out at sea, in the air, in an old land plane that creaked and shivered at every change of angle or elevation, and over what perhaps is the roughest stretch of water in the north Pacific Ocean! I shut down the motor a bit, tapped the shoulder of the pilot and shouted: 'Say, ya know we've got only three-quarters of a gallon of gasoline left!'

"He hollered: 'What?'

"I yelled again: 'The gauge shows only three-quarters of a gallon of gasoline left!'

"Imagine my delight when he shouted disgustedly: 'The gauge?—Aw, that blamed thing don't work!'"

Hal Roach Talkies

Under an agreement made today, the Victor Talking Machine Company will assume full charge and responsibility for the creation of appropriate musical scores and the recording of all synchronized productions of the Hal Roach Studios.

Announcement to this effect was made today by Mr. E. E. Shumaker, President of the Victor Company. In commenting on the subject, Mr. Shumaker said. "The art and technique of Victor's sound recording laboratories will be added to the skill and creative ability displayed in the productions of the Hal Roach Studios as a result of a contract executed today. It is a pleasure to announce this further step in the progress being made to bring the technique and experience of our organization, resulting from years of activity in the business of recording and reproducing sound to the side of the art of recording and reproducing action by photography. A combination of the best efforts of highly developed experts in their respective fields should, and I am certain will, result in advancing the development of better and more entertaining talking pictures."

Anticipating the completion of negotiations, several members of the Roach organization are already in Camden conferring with Victor staff, and Victor engineers are en route to study the studio requirements on the Coast.

Applicability of Sterescopy to Motion Pictures

(Continued from Page 13)

laboratory facilities and generously endowed may solve the problem.

We assume that this problem excludes the use of optical devices by the audience.

E. Burton Steene

A. S. C.

Cinematographer

Now completing one year of Akeley Camera aerial sequences for

"Hell's Angels"

A Caddo Production for United Artists Release

Directed by Howard Hughes

Harry Perry, A. S. C. Gaetano Gaudio, A. S. C.

Chief Cinematographers

Now on location at Oakland Airport
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these corrections are especially advantageous.

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Visual Education Triumphs

Marked superiority of children taught with films over children taught by other classroom methods was demonstrated at Rochester, N. Y., October 16, when the most extensive experiment ever undertaken in education was formally completed. A 33 per cent greater gain in geography and a 15 per cent greater gain in general science were scored by approximately 5,500 children taught with films over 5,500 taught the same subject material without the aid of motion pictures, in a trial in public schools in twelve widely scattered cities, directed by Dr. Ben D. Wood, of Columbia University and Dr. Frank N. Freeman, of the University of Chicago, as set forth in their 50,000 word report on the experiment which was conducted over a period of ten weeks last Spring.

Films Would Reduce Failures

If properly planned classroom films can raise pupils' marks by an average 24 per cent as in this experiment, the report indicated, many failures will be turned into passing marks, since the great majority of failures are by less than 24 per cent. Thus the time required for repeating courses will be saved in many children's education, and large costs will be saved to municipalities. The average expense of keeping a child in school for a year is $100, which in Chicago, for instance, where there are 30,000 failures a year, would mean a saving of $3,000,000 a year if they could be completely eliminated.

The experiment, which represents the first time a nation-wide investigation has been made into the controversial question of the value of films in classroom teaching, was sponsored by the Eastman Kodak Company under the sanction of a committee of the National Education Association.

107,870 Test Papers Written

The superiority of the class work done by children taught with films was determined by Dr. Wood and Dr. Freeman on the basis of 107,870 test papers written by the 11,000 children before and after the ten weeks of the experiment and periodically during the course of it. Both the classes taught with films and those without used the same "study guides," according to the educators' report, and were given identical tests.

The school authorities in the twelve cities cooperated with the investigators by selecting classes of children and teachers for the two groups as nearly as possible equal in ability, and the experiment was a regular part of classroom work. The films used were of the 16 mm. "amateur standard" size and were of "safety" material so that they could be projected right in the classrooms without the use of projection booths.

"In this experiment," the report said, "we have studied the films not as a panacea to be substituted for present instrumentalities of the schools, nor as a means to revolutionize the aims of education, but as an addition to the present pedagogical devices of the schools which may help in the attainment of currently accepted goals."

"Relate Lessons to Experiences"

In addition to the final advantage that the written tests showed for the film-taught children, reports from the teachers who used films in teaching their classes and from school officers showed that a large majority believed the use of classroom films to have been "more effective in arousing and sustaining the children's interest, in improving the quantity and quality of their reading, and in aiding them to correlate features of the lessons with personal experiences and community conditions."

The films used in geography teaching were: "New England Fisheries," "Wisconsin Dairies," "Wheat," "Wheat to Bread," "Cattle," "Corn," "Cotton," "Irrigation," "Bituminous Coal" and "Iron Ore to Pig Iron." Those in general science were "Hot Air Heating," "Atmosphere Pressure," "Compressed Air," "The Water Cycle," "Water Supply," "Purifying Water,'" "Limestone and Marble," "Sand and Clay," "Reforestation" and "Planting and Care of Trees." These films had been made particularly for the experiment by the Eastman Kodak Company under the direction of Dr. Thomas E.

(Continued on Page 23)

Notes on Making Duplicate Negatives

C. E. IVES *and* E. HUSE

Communication No. 356 from the Kodak Research Laboratories

The fundamental principles underlying the preparation of first quality duplicate negatives were established by Capstaff and Seymour[1] in a paper published less than two years ago, and shortly afterwards practical instructions on the use of duplicating film were issued.[2] Since the appearance of these publications, however, further experience has been gained relative to the use of duplicating film, and the present paper contains practical notes summarizing the results of this experience.

Making the Master Positive

When printing the master positive, the first requirement is that sufficient exposure be given so that all tones of the original are recorded faithfully. A good master positive appears much denser than the average projection positive, and to the inexperienced, may seem to be seriously over-printed. No master positive or duplicate is satisfactory if the density of any part of the image is less than 0.5. The least dense portion of the image should be compared with a sample of film having a uniform density of 0.5. The best way to do this is to bring together two cut edges of the areas to be compared in front of an illuminator. The 0.5 density sample can be chosen from an assortment of strips of developed film which have received various exposures as follows: A line made on a sheet of white paper by a single firm stroke with a No. 3 pencil is just invisible in strong daylight through two thicknesses of film of the required density when pressed firmly against the paper.

The reason why it is necessary to give a full exposure to the master positive so that it appears much denser than the average projection positive is seen by reference to Fig. 1. This represents a developed strip of duplicating film which has been exposed in such a manner that each rectangular area received an exposure definitely greater than that given the preceding area. It is seen that throughout the middle portion of the strip from B to C these regular increments in exposure produce regular increases in density, that is, the tone reproduction is correct. At both ends of the strip, however, it is quite apparent that increasing exposures do not produce corresponding increases in density, that is, the tone reproduction is false.

It is obvious, therefore, that the lightest portion of the master positive should be given an exposure at least as great as that which the step B received, and for an average degree of development this corresponds to a density of about 0.5.

If the density contrast range of the original negative is very great, the shadows of the master positive will be rendered in the exposure range C, D, and the reproduction will not be true. However, the latitude of duplicating film as represented by the exposure range B, C, (Fig. 1) is sufficiently great to take care of all but extremely contrasty negatives.

The best known method for finding the correct exposure for the different scenes when printing the master positive is to make use of a motion picture sensitometer such as that described by Jones and Crabtree[3] or a modification of this.[4, 5] Test strips exposed through the different scenes in the original negative should be developed in the regular way and from these the comparative exposure requirements of the different scenes can be judged. Also, if the sensitometer has been equipped with a single thickness of the recommended violet filter (Wratten No. 39 Duplicating), and if the proper degree of development has been given, an evaluation of contrast variations in the original negative can be made. It is advisable to equip the sensitometer with the filter because one thickness of filter is almost invariably used when printing the master positive.

Control of Contrast of Master Positive.—As previously explained, [1, 2], it is necessary to develop fully duplicating film in order to obviate development defects. However, the contrast of many original negatives is so great that the master positives and duplicate negatives would be too contrasty if development were carried to completion. In such cases contrast may be reduced by the use of violet filters in the path of the printing light. It is a property of the yellow dyed emulsion of duplicating film that increased contrast is obtained when yellow light is used for printing and decreased contrast when violet light is used. When printing with white light, the contrast is increased moderately. Unless abnormally high or low contrast is required in the duplicate negative, one thickness of violet filter is used in making the master positive so that the contrast of the original is reproduced exactly.

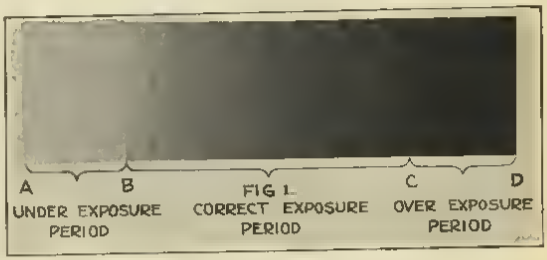


FIG 1.

A simple method of comparing the contrast of the master positive and the original negative is to superpose identical frames of each. If the two images are entirely blotted out, it means that the contrast of the two images is exactly equal. If there is a residual image, the master positive is slightly more contrasty than the original, and (if one filter has been used in printing) this indicates that the development was excessive, and **vice versa.** Development is correct if the contrast is reproduced exactly when one thickness of filter is used.

In duplicating film, the yellow dye limits the contrast obtainable, so that when development is complete, the contrast is not excessive. Contrast should be regulated only by the use of filters in order to avoid the "halo" effects which would result if contrast were lowered by cutting the degree of development. [1, 2]. Development should never be less than normal, except when the original is extremely contrasty and when two thicknesses of filter have been found not to give sufficiently low contrast. The cut in the degree of development should be as small as possible, but in any case this involves a danger of producing objectionable development defects. By using one or two thicknesses of filter, the desired contrast is ordinarily obtained. If no filters are used, the contrast is increased considerably.

By examining the test exposure made on the sensitometer, those scenes may be noted which would be improved by increasing or decreasing their contrast in relation to that of the other scenes. More or fewer filters are used when printing the master positives of these scenes. Little advantage is gained by the use of more than two filter thicknesses.

Processing the Master Positive.—Most uniform results in processing have been obtained with continuous machines. Other methods are unsatisfactory because local irregularities appear in the form of rack marks or streaks,[6] and it is difficult to duplicate exactly the degree of development.

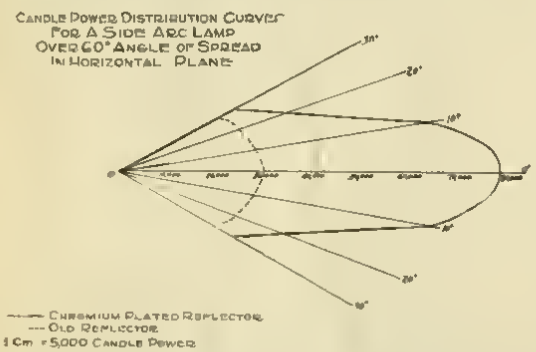
The type of machine to be employed is not important, providing the time of development can be controlled. Agitation of the developer is quite necessary to eliminate any tendency for streakness. Slight uneveness in development which would not be serious in regular work is very serious when making duplicates.

(Continued on Page 25)

Improved Reflectors for Side Arc Lamps

In the investigation of conditions surrounding the lighting of Motion Picture Studios on the West Coast, representatives of the National Carbon Co., Inc., have been impressed by the lack of utilization of the light at full efficiency. Particularly has this condition been noted in the side arcs which are of the twin arc type burning two arcs in series on approximately a 110-volt line. These findings have been corroborated by Mr. Loyd A. Jones in a paper entitled "Photographic Characteristics of Motion Picture Studio Light Sources," presented by him at the Hollywood Convention in April this year.

In the studies looking toward the improvement of various units used in lighting studios, it was found that a very considerable part of the poor utilization of the light from these side arcs was due to the kind and design of reflectors used. It appears that the really useful light from a side arc is included within a solid angle of 60 degrees. This opinion was confirmed by Mr. Farnham in his paper on "The Effective Application of Incandescent Lamps for



Motion Picture Photography," also presented before the Hollywood Convention. As a result of these studies reflectors, designed upon the above premise, have been developed by the laboratory of the National Carbon Co., Inc.

A number of reflecting surfaces were considered. A good glass mirror would, of course, be the best material for directional reflection. Due, however, to the desirability of having rugged equipment in the studios, glass mirrors were eliminated from consideration. This limited the selection to polished metal surfaces. Of these, polished silver, which reflects 92 per cent of the incident light, is the most efficient, but silver tarnishes quickly. Of the other polished metals, chromium, aluminum, nickel, tin and steel, all directly reflect 55 per cent to 65 per cent of the incident light.

From a consideration of the fact that such a reflector would be exposed to high temperatures and hard usage, it was decided to use chromium surfaces, which are the least subject to tarnishing. This surface is very pleasing in appearance and incidentally gives the highest percentages of direct reflection of visible light (65 per cent) of any of the metals mentioned, except silver. It is very easily cleaned with any kind of cleaning material. It is also well known that chromium surfaces are extremely hard and difficult to injure, and thus are a very desirable surface for use where such qualities are required. Sheet copper nickel-plated and then chromium-plated was selected as the most durable for the conditions to be encountered.

In the interest of economy, designs for reflectors have been made for the lamps now in general use in the studios. These designs, when made up in the copper-nickel-chromium manner referred to, have increased the effective light by approximately 100%. The first figures shows the increase in effective light obtained from one of the types of lamps now in use.

Figure No. 2 shows the recommended design for the top and back reflectors for one type of lamp. Figure No. 3 shows the design recommended for the bottom and side reflectors for the same lamp. Figure No. 4 shows the design recommended for the top and back of reflectors for another type of lamp in general use in the studios, and Figure No. 5, the bottom and side reflectors for the latter lamp.

Figures 2 to 5, inclusive, represent working drawings giving full details of the construction of the newly suggested reflectors.

(See Designs on Opposite Page)

A British branch of the Society of Motion Picture Engineers—an international body devoted to the artistic and technical development of the film industry, with headquarters at Hollywood, U. S. A.—was formed at a meeting at Kingsway Hall last night.

Dr. K. C. D. Hickman, one of the little band of talented English workers attached to the Eastman Research Laboratories in the United States, explained to the meeting, which was attended by prominent members of the British film-producing industry, how essential it was, if that industry was to progress and prosper, that there should be some society or organization for pooling all scientific and technical knowledge. This need had been met in America by the foundation in 1916 of the Society of Motion Picture Engineers The society had gradually widened its scope, so as to include every aspect of production, artistic and scientific

After a prolonged discussion, in which, among others, Mr. George Pearson, the well-known producer, and Captain J. W. Smith, of the Williamson Film Printing Company, took part, it was announced that nearly thirty members of the British industry, including the two just named, had decided to become original members of an English branch of the society. Dr. Hickman had asked for a minimum of ten.—London Daily Telegraph.

CAMERA RENTALS

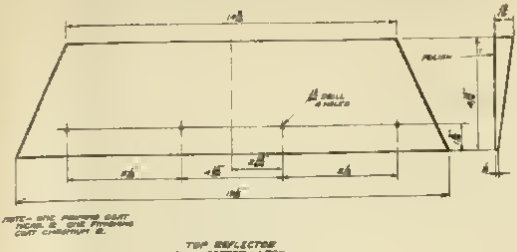
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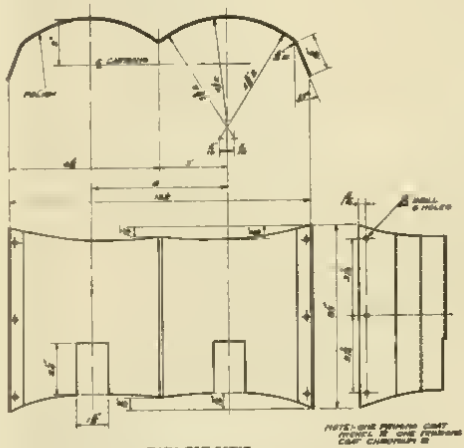
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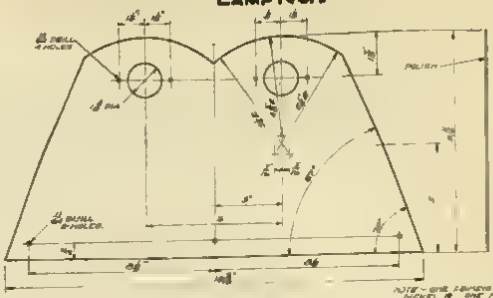
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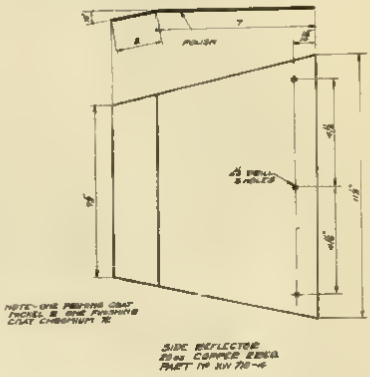
Top and Back Reflector Design Lamp No.1



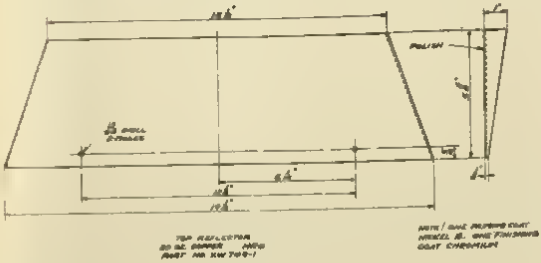


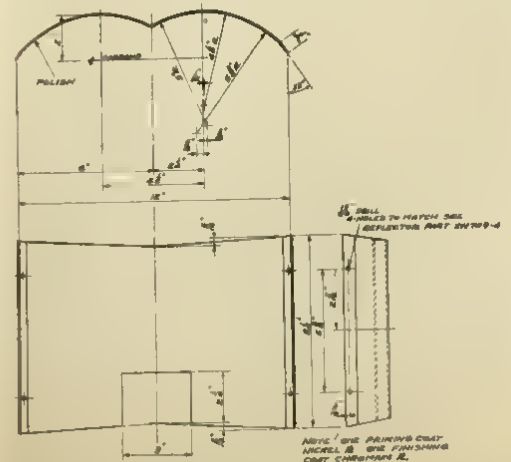
Bottom and Side Reflector Design Lamp No.1



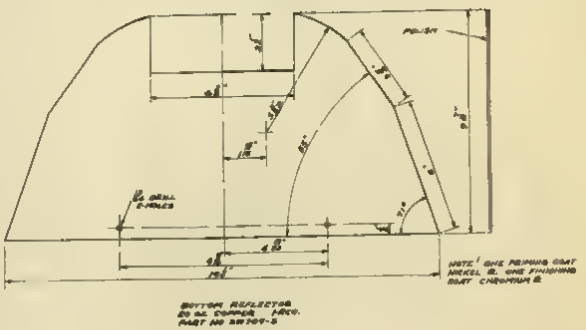


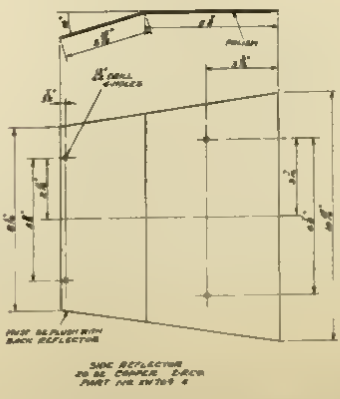
Top and Back Reflector Design. Lamp No. 2





Bottom and Side Reflector Design. Lamp No.2





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(Continued from Page 4)

porting and no other periodical appertaining to moving pictures can match this record.

Many more facts of interest regarding the "Voice of the A.S.C." could be set forth, but here is enough to give our readers a fair idea of the qualities of our magazine and to convince them that it has a legitimate appeal to all directly or indirectly interested in things cinematographic.

The AMERICAN CINEMATOGRAPHER, while taking its eighth bow before its clientele, takes occasion to express its gratitude to those subscribers, advertisers, contributors and friends who have through the years helped the little magazine to fight its way to its present place in the cinematographic sun.

The "Voice of the A.S.C." thanks you.

Paul Perry, A.S.C., and Roy Eslick, A.S.C., have just finished George Melford's "Love in the Desert," which took them to Yuma for the desert sequences.

The front cover of THE CINEMATOGRAPHER for November is by Karl Struss, A.S.C., one of the noted pictorialists of the industry. Mr. Struss has won international recognition for his photographic art and the A.S.C. is proud of his achievements. Our original A.S.C. front covers are attracting favorable notice everywhere

Charles Stumar, A.S.C., is leaving for Europe for Universal Pictures Corporation, to shoot several quota pictures in Berlin, Germany.

On the F. B. O. Lot

Phil. Tannura, A.S.C., just completed the miniature work for Bert Glennon's "The Air Mail."

* * * *

Bob Martin, A.S.C. and Bob DeGrasse, A.S.C., are with George Seitz at Catalina Island, making a story called "Blockade."

* * * *

Nick Musuraca, A.S.C., is getting his heavy red flannels read for Mammoth Lakes for a snow picture, with Jerry Storm directing.

* * * *

Norman DeVol, A.S.C., is again with Tom Mix, making "The Drifter."

* * * *

Virgil Miller, A.S.C., just completed Bob Steele's "The Amazing Vagabond"—Wally Fox directing. They spent several days at Santa Cruz, among the big trees and around the saw mills. Virgil is getting ready for Bob's next one, which will also be directed by Wally Fox and will take them to San Diego via boat for one sequence.

* * * *

Virgil Miller says "F.B.O." means "First Bunch Out" —Perhaps that is why we met them going over the pass in the wee small hours the other morning.

Alvin Wyckoff, member of the Board of Governors of the A.S.C. and also president of the International Photographers of the Motion Picture Industry, will have an illustrated article on his recent trip to Canada in the December issue of THE AMERICAN CINEMATOGRAPHER.

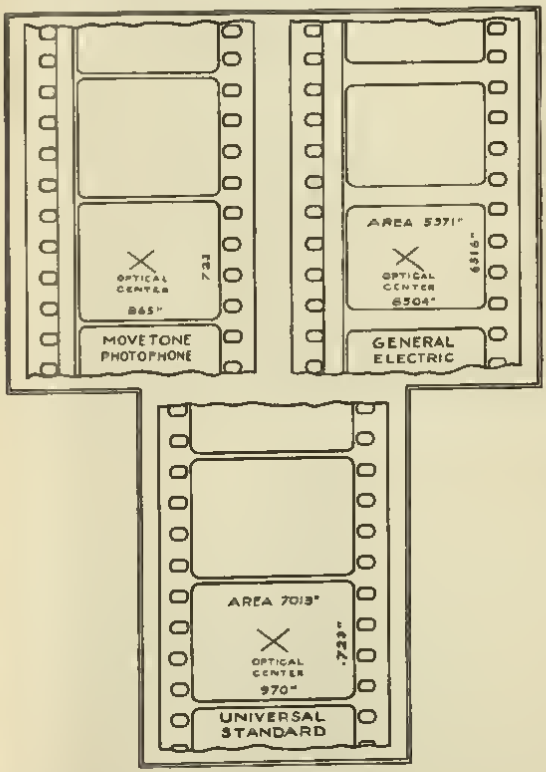
On the Altar of Sound

By FRED WESTERBERG, *A.S.C.*

It must be evident to the most casual observer upon looking at the present crop of motion pictures, especially those employing the photographic method of recording, that cinematography is being sacrificed on the altar of sound.

Apparently the "talk" in "talkie" is being counted upon to overwhelm our sense of hearing with fascinating sounds to such an extent as to leave all powers of perception relatively numb to visual stimuli, good or bad.

A story comes to mind of a young man who was assigned to grease the wheels of a wagon. Later it was



found that only the front wheels had been greased. When questioned, the young man replied that he was of the opinion that as long as the front wheels went around the rear wheels of course had to follow.

In this new sound picture situation it seems that cinematography is going through the motions of being a rear wheel in need of grease. If the wheels of sound revolve perforce the wheels of cinemstography must follow.

It can hardly be expected that the electrical sound engineers, immersed as they are in their own problems, totally foreign to the practice of cinematography as an art and as a factor in the economy of picture production, would always consider fully in the development of their devices the needs of the cinematographer.

(Continued on Page 22)

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When the process of sound reproduction operates as an independent unit, such as it does in the various phonographic methods, cinematography is not greatly concerned. Certain limitations are imposed it is true, such as the use of sound-proof booths for the cameras and the necessity of using incandescent light, but cinematography has nothing to lose in acquiring a mazda lamp technique or in being forced to find a way to make the cameras silent in operation. But when sound reproduction, as embodied in the various photographic methods, enters vitally into the cinematographic process and degrades it, the cinematographer can no longer afford to remain quiescent.

When such is the state—as we have it with us now—it becomes necessary that the problems of cinematography be duly considered and acted upon while the sound process is being developed, standardized and adapted to the needs of motion picture work.

Let us examine a few of the factors of sound production that are now at work to undermine the cinematographic structure.

The camera in many cases has been saddled with a great deal of accessory machinery, the hindrance of which only a cinematographer can appreciate. Simplicity, accessibility and mobility of camera equipment is one of the main factors on which the cinematographer depends for efficient and economical performance of his duties.

Any method that burdens the camera with more than a synchronous motor is not desirable.

Anybody who has ever sat near the front in a large theatre will readily appreciate this factor.

Much harm has been done by forcing the cinematographer to give up picture space to make room for a sound track.

It has imposed upon the industry the new picture size of about 18x24 millimeters.

Based solely on its own merits this size has no valid claim to warrant its adoption as a new standard.

This shape has been foisted upon the cinematographer simply to meet the exigencies of sound production.

This shape is so nearly square as to seriously limit the scope of this proportion artistically and furthermore it is not centered on the optical axis of the camera lens.

Is this a tribute to the artistic soul of the cinematographer that he is capable of indifference to such an obvious and irritating lack of precision?

Another shape of approximately 16x21 millimeters, which was at first adopted in the variable area system of General Electric, while presenting an acceptable proportion is smaller in area by nearly 25% which increases materially the problem of grain due to the greater magnification necessary when projected on the screen.

Anybody who has ever sat near the front in a large theater will readily appreciate this factor.

When the cinematographer is not only forced to give up space on the positive print, but also must share the exposure on the negative, the situation is bad indeed for it entails a degree of loss in the control of his medium beginning on the set with the operation of the camera and carried on through into tha laboratory.

Despite assurances from the scientists of sound that standard and unvarying conditions of development (necessary for the sake of the sound record) will automatically give the picture record the best possible treatment many cinematographers will insist that deviation from standard conditions of exposure and development under certain conditions is absolutely necessary in order to achieve the effect they desire. Fortunately for the cinematographer and for the sound technicians, too, probably, tha practice of combining the sound and picture record on the same negative is losing ground.

In the final printing of the picture and sound records for release the film has to be run through the printing

(Continued on Page 27)

Visual Education Triumphs

(Continued from Page 16)

Finegan, formerly Deputy Commissioner of Education in New York State and Superintendent of Public Instruction in Pennsylvania.

The twelve cities that participated in the experiment were Rochester, N. Y.; New York City; Chicago, Ill.; Detroit, Mich.; Newton, Mass.; Atlanta, Ga.; Winston-Salem, N. C.; Lincoln, Neb.; Kansas City, Mo.; Denver, Col.; Oakland, Cal., and San Diego, Cal.

To Minnesota

President John W. Boyle, A.S.C., announces that Mr. Joseph Dubray, secretary of the Society and technical editor of THE AMERICAN CINEMATOGRAPHER, has been unanimously chosen by the Board of Governors to fill a speaking date at the University of Minnesota on November 22nd, in response to an invitation from that great institution of learning.

The invitation, extended some two months ago through Mr. James Lawrence, assistant to the president, is regarded by Mr. Boyle and the Board of Governors of the A.S.C. as being official recognition of the importance and standing of the Society in the world of the cinema and as an indication that the great educational institutions of America have definitely organized for the promotion of motion pictures as an art, as an educational factor, as an influence for good and as a constructive agent in the world's work.

Mr. Dubray has been asked to speak to the student body of the University on the general subject: "Why Men Give Their Lives to Know More About Their Environment." This address will be delivered in the morning and, in the afternoon our speaker will entertain the faculty and advanced students with a discussion of the psychological and philosophical phases of the cinematographic art and his lecture will be embellished by the showing of special film secured with the co-operation of members of the A.S.C.

President Boyle anticipates many calls of this nature in future and is laying plans to take advantage of them. The A.S.C. has a wealth of talent that can be directed into educational lines.



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Notes on Making Duplicate Negatives

(Continued from Page 17)

Timing the Master Positive.—The exposures for the various scenes of the master positive can be determined as follows:

1. By timing the various scenes with the aid of the sensitometer, taking care that the minimum shadow density of the resulting duplicate negative is at least 0.5. In this case the printing exposures of the various scenes will not necessarily be equal.

2. By determining the maximum exposure required by the most contrasty scene and then exposing the entire master positive at this printer light setting. This will insure that the various scenes in the duplicate negative have approximately equal highlight densities, or, in other words, they will require approximately equal exposures.

In case the master positive is underexposed, it should be re-made, because if tone reproduction is not correct in the master positive this cannot be rectified when making the duplicate negative. The same remedy is necessary in the case of serious over-exposures, although, as mentioned above, these are rare.

The Duplicate Negative

The general exposure level for the duplicate negative must be decided upon by making a trial print from a correct master positive scene. As with the master positive, sufficient exposure must be given so that every tone will be reproduced faithfully. **A perfect duplicate negative has no clear shadows even when made from an original negative which has clear shadows.** The shadows of the duplicate are always somewhat gray and while those in some scenes may be more dense than others, depending upon the range of brightnesses in the subject, none of them should have a density lower than 0.5. (See method of finding correct minimum density under **The Master Positive.**)

The characteristic result of under-exposure of the duplicate negative is a lack of quality in the shadows of the final positive.

Contrast of Duplicate Negative.—Such control should be exercised over the contrast of the duplicate negative that it will be suited particularly to the use for which it is intended. In general, no contrast adjustments from scene to scene are made in printing the duplicate negative. The same number of filters is used throughout and all of the negative is given the same development.

Machine development is especially desirable when making the duplicate negative. It is only by the exercise of extreme care that two strips of film developed by the rack or drum method can be made exactly alike in density.

Improvement of Quality by Duplication.—With the exercise of a little care it is entirely possible to make from any original negative a duplicate which has the same contrast and printing density throughout. The elimination of waste and the increased efficiency of operation made possible by the use of such a uniform negative are matters of great importance to laboratories.

When preparing such a duplicate negative the exposure given in making the master positive should be such as to make the various scenes as nearly perfectly uniform in quality as possible. This does not mean that each scene will have the same highlight density but rather that each scene will have the same appearance as regards quality.

In general, it has been found best to equalize the contrast of the different scenes during the making of the master positive. This is because the violet filter reduces contrast by lowering the high densities. When making a uniform master positive, the lighter portions of the image should be equal in density. The introduction of a violet filter into the light beam causes little change in the positive highlight densities so that very little, if any, readjustment of the light change setting is necessitated. On the contrary, if a filter is introduced into the light beam when making the duplicate negative from the master positive, more exposure must be given, otherwise the

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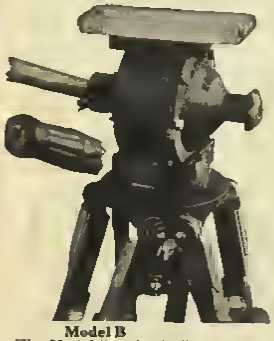
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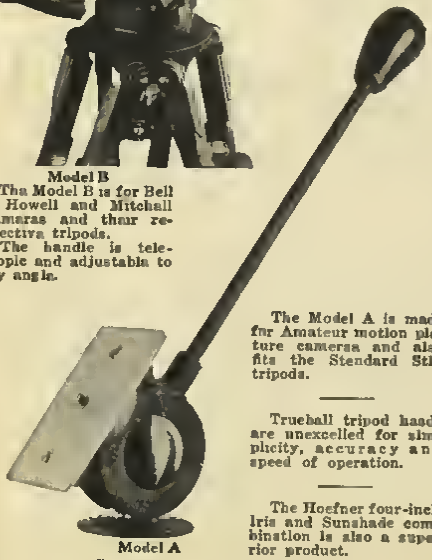
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higher densities will be reduced and the negative will not be uniform as printing density.

The quality of the master positive should be sufficiently uniform so that a duplicate negative can be made by printing through it at one exposure which will require no light changes when the final print is made. Sometimes it is necessary, when printing the duplicate negative, to make some slight allowances for variations in the master positive, but the corrections required at this stage should be as small as possible because, if any scene in the master positive should be much less dense than normal, or very much denser, there is the possibility that faulty reproduction of tone will result; and it is not always possible to make large allowances for such density variations with sufficient accuracy.

A means of checking the positive quality and measuring the correction to be applied is advisable where first class results are required with a minimum loss of time and materials. Non-uniformity in the positive can be taken care of by either of the following methods:

(a) Sections of the master positive can be remade until satisfactory.

(b) Exposure allowances can be estimated by examination and applied in making short trial exposures from each scene. The accuracy of the estimate cannot be judged from the appearance of the trial negatives so a print must be made from them at a constant exposure. Then if the print quality is satisfactory, the duplicate negative exposures are correct and the complete negative can be printed.

Printing Equipment for Duplicating

A printer for duplicating work must be absolutely steady, the exposure must be perfectly uniform over the aperture area, and constant as the machine runs, while nothing less than the best possible definition is acceptable. A printer should be tested rigidly in this connection before it is put to use for duplicating.

The Light Source.—A strong source of light is necessary so that duplicating film can be printed at normal speed. A 25-volt concentrated filament lamp fed by storage batteries, in conjunction with a relay condenser system, is very satisfactory. A 100-watt lamp with an efficient optical system gives ample exposure for the most dense negative when the printer runs at a speed of about 15 feet per minute. If a condenser is not used, a 300 to 400-watt lamp will usually give sufficient exposure.

The light control should be capable of varying the light by very small steps. A resistance light change is unsuitable for making duplicates because the color of the light has an influence on the contrast of the print. A well-built mechanical diaphragm designed to eliminate inaccuracies in setting serves the purpose well. An optical wedge permits a very satisfactory alternative control.

The violet filters should be mounted in such a way that they can be shifted in and out of position as quickly and readily as a light change is made. Gelatin light filters are somewhat sensitive to light and tend to fade, but stable glass filters are now available. The filter should be placed at a considerable distance from the lamp, preferably beyond the shutter in a step printer and in such a position to be benefited by the light control. In any case, it should not be so close to the gate that dust particles adhering to its surface will throw distinct shadows on the film.

The Printer Gate.—The necessity for perfectly uniform and intimate contact between the two films during printing has been emphasized previously.[2] The curved gate recommended for contact printers[2] has continued to give satisfactory results. In building these gates it was found that small imperfections in the alignment of the gate and bed plate could cause serious trouble. It is necessary that the curved member be fitted to the bed and the fixed side rail with extreme accuracy, otherwise the film will be buckled at the aperture. The rollers must be machined accurately and must be fitted to the shaft closely. They must be parallel to each other and to the bed within ± 2/1000 of an inch. The distance between the rollers and the bed plate should be between

On the Altar of Sound

(Continued from Page 22)

machines twice, once to expose the picture record and again to expose the sound record. In order to overcome this economie waste the practice has grown up of making a "dupe" negative in which tbe sound track is properly adjusted to the picture in regard to botb exposure and synchronization. Such a negative greatly simplifies the printing operation and reduces the cost but the result, photographically, leaves mucb to be desired. This is especially noticeable wben a comparison is made with otber scenes in the same picture that have no sound accompaniment.

Thus all roads lead to Rome. In this case we are forced to the conclusion that the sound record does not helong on the motion picture film—that a grave error of policy has been made in so joining the two. Let us face this issue squarely. Photographic reproducion of sound has a manifest destiny but not as a parasite on the motion picture record. It must put down roots of its own and the tap root must be a cheap, simple independent vehicle for its record.

Under present conditions a separate sound record occupies about one-eighth of the available area on the film. To use such a record sepsrately in the theatres would be obviously costly and wasteful. In some cases the photographic record is transferred to a phonograph disc for release. This, however, is still begging the questions, because, while it gives cinematography necessary consideration, it forfeits the possibilities of the photographic method of sound reproduction in regard to quality for the sake of the cheapness of the phonograph record.

The answer then is to transfer the sound record as obtained independently on motion picture film not to a phonograph disc, nor to the picture film, but to a separate photographic vehicle at low cost.

It is conceivable that such a record could be placed either spirally on standard film and thus make use of the full width of the film or as a single track on very narrow film or even spirally on a cylinder.

Here at any rate is an opportunity for research and invention in response to a basic need.

Cinematography is glad and willing to be a brother to sound technology, but it has no desire to have him as a Siamese twin.

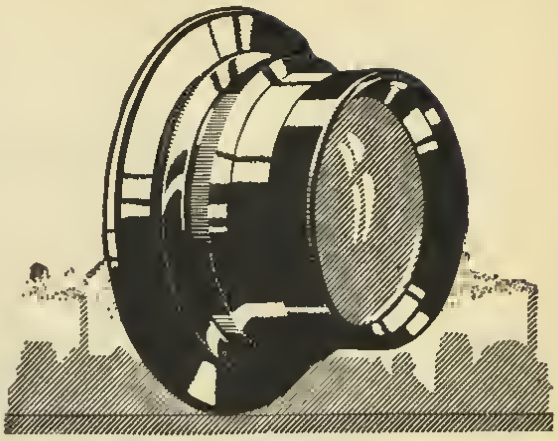
18 and 25 thousandtbs of an inch. The shoes should be made carefully and must move freely under the spring tension of two-thirds of an ounce. All surfaces in contact with the film require a high polisb to prevent scratching.

In tbe case of most gates whicb bave been in use and are to he converted to the curved type, it is necessary to rebore the hinge brackets and to fit new hinge pins, otherwise the play at this point will make it impossible to bring the moving portion to exactly the same point of rest every time it is closed.

Pull-down claws which are badly mounted or which have become undercut or "hooked" from wear should be renewed.

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There are several exterior shots in this picture which are certainly very near photographic perfection and I thought you would be interested to know that I am making a personal request of the producer for clippings from some of these "takes" which I intend to send to the officials of the Kodak Company at Rochester.

The fine shading and the delicate color separations which, through your efforts, have been given to this production, very definitely emphasize the care and study which you have put into every shot.

I want to take this means of inviting your reference to me of any producers seeking your services as a cinematographer and I can assure you of my very sincere and wholeheartad support and commendation.

Very truly yours,

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Einstein Theory and the Fourth Dimension

By H. GERNSBACK
Member American Physical Society
Editor Science and Invention
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[There are few subjects so difficult to explain in simple language as the Einstein theory and the fourth dimension. The present article, which covers the most important phases of the Einstein theory, aims to instruct the reader in a popular way and in plain English devoid of all technicalities. We believe little difficulty will be found even by the average school-boy in understanding the subject. In an article of this kind it is, of course, not possible to cover all of the various phases without going into mathematics and for that reason such phases have been covered by means of analogies as much as possible. It should be noted that the views expressed by the author are those held by most physicists today. But as there is very little known on such subjects as, for instance, light, gravitation and space, it is quite likely that our present-day views will be modified from time to time. This is the first time that the Einstein theory and the fourth dimension have been explained in a strictly popular, non-technical manner, and we hope our readers will appreciate the present effort.—AUTHOR'S NOTE.]

[This article is reproduced by request of A. S. C. members who desired a non-technical presentation of this abtruse subject. It is said that only a dozen men in the world fully understand Einstein's theory, but the generalities are not difficult of comprehension.—EDITOR'S NOTE.]

Volumes have been written during the past few months about the now famous Einstein theory of relativity and the fourth dimension. As for the latter, this is not a new subject, having long appealed to the delvers into the occult and to adherents of spiritism, as well as those who reason solely by metaphysics.

Thus, for a long time students of the fourth dimension had an entirely different conception from what physicists think it today. In their earlier fourth dimensional world, for instance, it was thought possible that you could turn an orange inside out without breaking its skin. Or you could remove a patient's appendix without making an incision in him. In other words, among many other similar absurdities, they thought that in the fourth dimensional state, every three dimensional body could be turned inside out the same as you turn a glove or a sock inside out without in the least damaging it.

Since Einstein has appeared on the stage, however, this trend of thought has disappeared, and our present conception of the fourth dimensional world—if indeed it exists—is totally different from the old concept. We will, however, come back to this later.

In order to become better acquainted with the Einstein theory, let us first cite the fundamental experiment upon which his researches are based.

About Relativity:

The velocity of light, which is about 186,000 miles per second is unaffected by the movement of its source. Let us first make this plain by an analogy.

If a man in a train going sixty miles an hour throws a ball in the same direction as the train, and at the same speed, the velocity of the ball in relation to the earth is 120 miles an hour. Suppose this ball was thrown from the engine toward the rear. Then the velocity of the ball in relation to the earth would be zero, and if the ball were thrown from the rear platform, it would drop vertically to the ground. This is a simple matter of relativity; this expression means that **the movement of the ball is relative to the train, as well as relative to the earth.**

Now consider a ray of light. Here an entirely different phenomenon takes place. It makes no difference whatsoever if we have a searchlight mounted on the locomotive of a moving train throwing the light backward, or if we have the searchlight on the last car of the train throwing the light forward with the train. **The speed of the light is absolutely unaffected by such motion.** Not only is this true of the light placed on a moving object, but it is also true for an observer stationed on the ground. Strange as it seems, the speed of the light ray either coming toward him or moving away from him is not at all affected by the speed of the train which carries the searchlight. This statement may be readily proved by the regularity of the apparent motion of several moons of some of our planets, as, for instance, the moons of Jupiter. At one part of their orbit these little moons are moving away from us, while at the opposite part of their orbit they are moving toward us. Yet they appear absolutely regular in their motion, proving that light coming from their surface takes the same time to reach the observer on earth whether the little moon advances or recedes from us.

If this were not so, the motion of the satellite would be irregular at all times. It might even happen that it would seem to move backward. This brings us to the famous Michelson-Morley experiment. This was originally based on the fact that light has the same velocity, irrespective of whether its source moved or was fixed.

To elucidate: Light for a long time has been thought to be merely a wave motion in the ether. This ether is supposed to surround us, filling the most minute interstices of all matter and, therefore, it must permeate the earth as well. Thus the earth is supposed to be entirely merged into this ether. Consequently, either of two things must happen, which we put in the form of questions: First, as the earth is speeding in its orbit around the sun, does it pass through the ether without disturbing it as, for instance, a fine wire-mesh sieve passes through water? And, if so, does it produce a sort of vortex or disturbance in the ether as it rushes through it? Second, does the earth push through the ether as the train pushes through the atmosphere, leaving behind it a sort of ether whirl and partial vacuum, just as the train leaves behind it a whirling eddy of air and partial vacuum?

The Michelson-Morley Experiment:

This question the Michelson-Morley experiment was supposed to solve. A light ray being a wave motion in the ether, it was naturally thought that a ray of light going in the direction of the earth should naturally move a trifle faster than a ray of light shot against the motion of the earth or at right angles to it. Then if there was a sort of **ether-drift** produced by either of the reasons mentioned above, accurate instruments would be enabled to detect the slight difference in speed. The famous Michelson-Morley experiment was originally based upon the fact that light has the same velocity, irrespective of the movement of its source. A ray of light was sent out to a mirror occupying a plane parallel to the motion of the earth, so as to go out and be reflected back to the observer. A second ray was sent out at right angles to this one in the direction of the terrestial motion, also to be received by a mirror and reflected back. The plane of the first mirror was arranged by measurement, at the same distance from the observer as that of the mirror for the other ray of light. One path is an



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isosceles triangle, whose base is the space moved over by the observer during the passage of light from its source to the mirror and back to him. At right angles thereto is the path of the second ray, which has to catch up with the mirror moving away from its source, and is reflected again to the observer. The effect of all this is that the rays will pass over paths of different lengths, and it was anticipated that they would reach the observer at different periods of time, one ahead of the other. This was what was anticipated as the result of the experiment which was intended to be a very convincing demonstration of the fact that the earth was moving through space. But when the experiments were tried, nothing of the sort occurred so that apparently **the longer path was traversed by the light in exactly the same time as the shorter one.** So scientists were called upon to explain what other causes there might be to produce the paradox. This led to the so-called Lorentz-Fitzgerald contraction theory. These scientists came to the conclusion that as there is no measurable difference in the speed of light in the above experiments, this could only be accounted for by having the earth shrink just sufficiently to account for the difference. In other words, as the earth moves forward in its path, due to its tremendous speed, viz., 65,533 miles per hour, it shrinks just a sufficient amount (about three inches) to account for the missing difference. In plain English, if we take a body and move it at a tremendous speed forward, **it shrinks in the direction of its axis** for a small amount, this amount increasing as the speed of the object is increased.

The Speed of Light:

Now it must be made plain right here that in order to shrink at all, these speeds must be tremendous, and as far as we human beings are concerned, our every-day lives will probably never be affected. In its axial rotation the earth revolves at a speed of 1,038 miles an hour. Low as this speed is compared to the 65,533 miles per hour of the earth's speed in its orbit around the sun, such speeds are never encountered on earth, as far as large bodies are concerned. Even our fastest projectiles, moving faster than anything known on earth, fall far short of this speed. But it has been maintained that a projectile shot from a cannon shrinks or rather contracts for a small fraction of an inch, which can be calculated. It should be understood right here that this shrinkage or contraction has nothing whatsoever to do with the air resistance. As is well known, the earth moves in a perfect vacuum; yet modern scientists think that the earth contracts just the same due to its speed. But what is a speed of 69,000 miles an hour (or 101,200 feet per second) compared to the speed of light moving at the rate of 186,000 miles per **second!** As far as the speed of light is concerned, the orbital velocity of the earth is insignificant.

Coming back to the contraction theory in the Michelson-Morley experiment, it becomes apparent that if the earth contracts a certain amount, not only the latter, **but the measuring instruments as well would shrink** in the same proportion, which would account for the fact that we cannot detect the difference in size which we hoped to measure. It is as if we were living in a world of curved mirrors. Take a man with divided rules or measuring sticks and place him in front of a cylindro-convex mirror. He naturally shrinks and **so do his measuring sticks.** The same man standing in front of a plane mirror will be reflected along with his measuring sticks in his true proportions; yet a man standing in front of a convex mirror, with axis vertical, will have his yard-stick contracted in the opposite side analogous to the man standing in front of the other convex mirror. Every measurement of this man would be wrong, and yet in a way the measure would be correct!

Once we admit the Lorentz-Fitzgerald contraction theory, we must also accept another equally astonishing one, and that is what we call the theory of **local time.** Take two clocks running together in perfect accord. If one of them is placed upon a moving platform, or if both of them are placed upon such a moving platform, their times will not be the same any longer, but will vary, in

(*Concluded Next Month*)

"I Will Do the Rest"

By ELIZABETH COLE

In this busy day and generation when everybody is trying to make a record of some kind—when the papers are full of "speed tests," and "new marks set," it's a good idea to give a thought to the hare and tortoise story. "Slow and steady wins the race" was the lesson in old Æsop's fable and there's more truth than romance in that motto.

We are burning up too much energy nowadays and it is a difficult problem to get people to realize just what "hustle bustle" and "doggone" tiredness can do to the body. A noted authority on fatigue study has said "exertion not only uses up temporarily the energy of the body but is also generates a sort of poison which slows down for the time being." As the amount of energy becomes more and more used up without giving the body sufficient periods of rest, the poison accumulates until it is a real menace. Naturally this means that time, effort and efficiency are wasted. While we may have speeded up and seemingly have produced a record breaker, we have in the end but thrown away our strength and energy.

Wasted time, caused by unnecessary fatigue, is really caused by ignorance—either our own or somebody else's. All the sound-proof devices, the inventions to save extraneous exertion, the modern improvements in factories and workshops will be of no lasting benefit toward promoting efficiency and comfort if men and women do not contribute their own individual intelligence in using them.

Fatigue is due to a chemical waste that circulates in the blood. Scientists have shown that certain chemical fatigue substances, when injected into animals, produce all the symptoms of fatigue. A tired person is a poisoned person. As long as there is a balance of rest, during which time the blood has a chance to purify itself (and nature has arranged for this). all is well. But when this chemical poisoning is allowed to continue for a period of time, it will poison the muscles, poison the brain, the heart, the blood, the whole body.

Chronic fatigue seldom is the direct cause of death, but it is very often the cause of frequent colds, grippe and what we call minor sicknesses, as well as of more serious sicknesses. When the body is run down, the resistance to germs is weak. Chronic fatigue is probably one of the causes of tuberculosis. Certainly fatigue is one of the early danger signs of that disease.

We must learn to be honest with ourselves and recognize when we are living on our nerve. We must not try to fool ourselves that we have only a temporary ennui, as we are so apt to do. When we are "fagged out," we should not be considered lazy if, for a few days, we apply that little rhyme:

"Since in laboring and in resting
Life is divided at best,
Let the others do the laboring
And I will do the rest."

"Sit down on the job," as it were, for those few days. Sit out in the sunshine and air—if it's a cold day, bundle up and do it just the same. If you haven't any yard to sit in—open a window and sit in front of that for a while. Relax your mind and don't worry about business, the baby's shoes or the next meal. Realize that if you don't favor yourself for a short time now, you may very likely have to take more "time off" later because of real sickness. Walk at noon, eat nourishing foods, drink plenty of water and, most important of all, go to bed early.

It is to teach the dangers of such sickness forerunners as fatigue that the National Tuberculosis Association and its affiliated associations carry on their educational campaign. In the past twenty-five years, the knowledge of how to prevent tuberculosis has caused the death-rate from that disease to decrease from 200 per 100,000 to 87 per 100,000 population in 1926. Their work is supported by the Christmas Seal Sales held annually in December.

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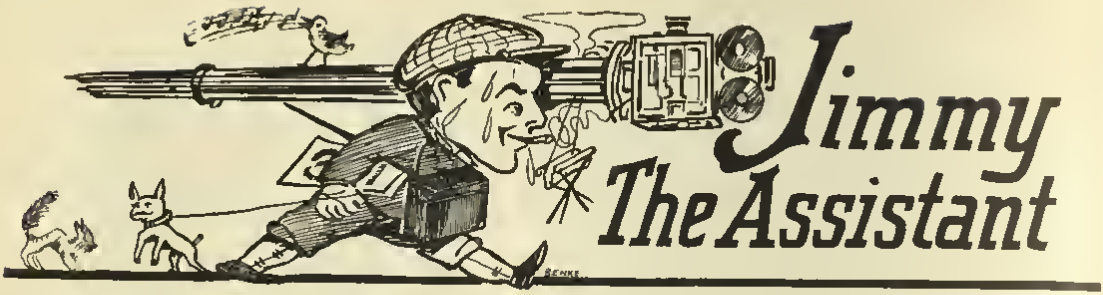
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YOUNG BLOOD

Sometimes it looks like the picture business just hates the thought of anything new. War pictures, crime pictures, Irish-Jewish pictures—regular sausage mill perduction of the same old hooey comes rolling out of the exchanges until it is enough to discourage almost any newcomer with new ideas into going hoeing corn again. But the one gleam of hope in the whole thing is the fact that someone had to **start** all these cycles; and that there's always a chance waiting for someone to start another—and grab the gravy attached.

That's in a general sense. In a particular way, it looks like the camera game was just as much in a rut as the perduction end. Almost any set is lighted like almost any other set. There's just so many things you can do, and that's about all you **can** do—so it seems. Everybody has the same chance to use the same film, same lenses, same everything that everybody else does. A new trick is old in a week—everybody knows about it and adds it to their list of things to do.

The chance for anything really new seems pretty hopeless, just as the chance for anything really new seems just as hopeless all along the line, from the perducers down. Actors are up against the same problem. What can a flapper do that hasn't been done—and done well, before? What is there left for an art director to do? About everything a person can think of to do to a set has been done, and over-done, many times. There ain't no new places to hide telephones—gold bath-tubs are played out—and they're kinda up against it. But since pictures have to be made, the art director puts the same old cob-webs in the same old deserted house; the character actor whitens the temples in the good old way; the flapper kicks up her heels when she gets kissed; the director makes 'em take it big; the perducer gives 'em what they have always liked; and the cameraman hangs yards of crape on their irises and wheels the camera all over the place until everyone's dizzy with art. That seems to be about all there is left to do.

The interesting thing about it all is that all of these here things were new at one time. Somebody had to think them up. Somebody will think up new things to do. They always have; and that's a good sign that they always will. Sooner or later it has to be done. The old boloney will go just so far, and then it bogs down. And it's to the credit of the business as a whole that whenever this happens there's always someone waiting and ready to step in with a new idea to substitute for the poor old worn out one. And it's to the glory of the business that nearly always these grand inspirations come from someone nobody ever heard of before.

The biggest hits in the picture business have been made—and nearly always have been made—by nobodies. An art director stood the kidding of the industry when he took a stevie on making a war picture when everybody knew that war pictures were taboo. And when the "Four Horsemen" came out it carried him to the heights of fame and set an unknown extra man on top of the world right along with him. Multiply that instance by the number of great successes in the industry, and you'll have the number of crowns of glory the movies should be proud to wear.

The fact that an unknown dub with the right idea can step in and own the industry within five or ten years if he plays his cards right is the great, grand and glorious lure of the gamble. It don't make no difference who he is, or where he comes from—if he can click with the box office's he's a cinch bet just as long as he plays the game with the same earnestness he brought to it.

This is true all along the line and the camera end of the game is no exception. The big cameramen of tomorrow are carrying slates today. The kids that are all hands and feet, stubbing their toes over tripods with three whiskers and a pimple on the end of their nose and making out reports that will always be a mystery even to themselves and handing you magazines loaded with positive stock only marked panchromatic and turning in every uncompleted lap dissolve they can find to the laboratory, so that you go into the projection room and see them just fade in and out over and over again—well, these are the guys that's going to be telling the directors just what they can and can't do in just a few years.

It always **has** happened that way, and there ain't no reason to think it won't keep right on happening that way as long as pictures is made.

The reason for that is that all along the line, in this business and in others, a fat salary and a lot of admiration brings a let-down of effort. A guy that's a success and has got the money and friends to prove it, naturally doesn't dig in as hard as some poor sap that has got to work like a son-of-a-gun just to make groceries. The guy that has arrived treats himself to a little relaxation—the other guy can't.

Then again, nearly everybody overlooks this one thing—What you get now you earned yesterday; and what you get tomorrow you are earning today. The guy that's arrived is just cashing in on the overtime he put in when nobody knew he was on earth. Naturally, he doesn't feel like using up any great gallons of midnight oil when he's sitting so pretty, so the good, old time-honored rut is just naturally slumped into.

Everybody thinks it's great, so why worry? But there's plenty to worry about just the same. No matter how good he is, he's got to keep bettering himself, and the better he is the harder it is to do. Not many of them figure it that way—and that's why we have new faces all the time.

Which is great. It keeps everybody on their toes, and that's what is needed. It weeds out the unfit and gives the real ones a chance. Nothing could be sweeter.

It creates another condition that looks tough but is really a mighty good thing for the industry as a whole. All along the line, from top to bottom, from president's chair to laborer, the incumbents are asking themselves, over and over again, one intensely important question, which is: "How am I to keep some upstart from horning in on my job? Here I am, sitting pretty, after having to fight the whole world to get here. Now how am I to hang on?"

The proper answer to that would be to outstrip competition. The ins have the chance in the world to do **that.** They have the confidence, respect and money power of the industry back of them. It looks like it would be a cinch. But it ain't, because it requires just one more ingredient that not all of them are willing to furnish, and that is—hard work; dealing chiefly with the region above the neck.

Without this nobody can get anywhere. The ones who furnish this hang on easily—or as easily as anyone can who bas to work for a living. But even then tbe cards are stacked against them.

They have unlimited money, respect, admiration, reputation and power on their side; and yet the game is stacked against tbem. Why? Because they have all these things to lose!

No idea is too wild for a beginner to try. If it flops, he has lost nothing, because he has nothing to lose. No idea is too safe for one who is established. He may lose his socks if it flops.

And that is the key to the situation.

If a beginner does anything that is just only pretty good, he gets a lot out of it, because you see, it's wonderful—for him! But if a great god of the industry turns out something that is a shade less than miraculous it's a sure sign that he is slipping—and, oh, boy!—how they do love to help him slip!

Now, naturally, the ones who are raking in the gravy ain't just going to sit still and let everybody in on the deal. Self-preservation is the first rule; and ways have got to be found so that they can preserve themselves without risking their gains or their jobs, and yet do it in auch a way that there's no hard work in connection with it. I mean, no unseemly competition with the rabble.

The answer seems easy. Keep 'em out. And they do, all along the line. Nobody can get a good job without qualification; and qualification means—past performance. Now, if a beginner is kept from making any performances he naturally won't ever have any past performances to point to.

It's a good idea—but it don't work. It never has.

Griffith broke through the bars of the Trust—the strongest and tightest organization ever designed to bar out an outsider. He did it at a time when they owned **everything**—cameras, film, projectors, theatres—everything. There ain't a dozen people working in the business today who don't owe him their jobs for doing that! Valentino crashed the star system when it was at its strongest—when nobody but a star could get **anything** out of a picture. Vidor drove into town in a flivver and broke the ring of master-mind directors who held all the power at that time. All along—all along—the whole history of the business is brilliantly lighted with brothers to incidents like these few.

Perhaps the finest comment on the whole situation is that the ones who fought them—who tried to bar their progress—who formed the apparently impenetrable barrier between them and what was their rightful place—these people have passed out without even their **names** being left in anyone's memory.

It's a grand game. Nobody with the right stuff in them will ever do anything but help a deserving youngster climb as high as he can; and the ones who try to hold him back only strengthen and sharpen his wits.

Young blood! It rules the game. It always has and it always will; and nobody can ever stop it.

Yours for younger and redder blood,

JIMMY.

Letter from Dr. Hitchins

Editor American Cinematographer:

I have recently had the privilege of spending six months at the factories of one of the largest producers of photographic materials in Europe, the object being a complete technical survey of emulsion processes for motion picture film and the putting into production of several new film and paper products; also making a rather intensive research on a number of matters relating to studio technique, lighting, make-up, panchromatics, laboratory methods and particularly sound reproduction for, to achieve success in tbis work, a highly specialized technique is essential, in the studio, in the laboratory and in the qualities, photographic and physical, of the film emulsion itself.

It was both surprising and gratifying to find that by applying the accumulated experience of many years of study of motion picture technique and materials that a closer relation between materials and practice was established, witb attendant amplification in many instances. It was also found that, in order to conform more readily to the most modern studio methods and production practice, changes were advisable in the photographic quality of several products, particularly in tbe field of panchromatics and sound, and also that laboratory and processing methods were in need of adjustment in keeping with the tremendous advance in picture quality that has taken place in the last few years.

In viewing, for purposes of comparison, hundreds of films, from almost all producers, countries and laboratories, one fact stood out pre-eminently—that the work of the American studios and cameramen is absolutely without rival.

The ever-increasing use of panchromatic negative film naturally led to a very thorough investigation of this subject and a number of special emulsions were made having peaks of sensitivity rather different from the standard panchromatic film, the object being to find a color response that would bring about a better rendering of make-up and also to allow of the use of filters, both compensating and contrast, so that any given color can be depressed in value, to complete extinction if desired, or intensified, and it is most amazing the effects of an illusional or trick nature that can be produced with the right combination of color response in the emulsion, proper selection of filter, the use of colored lights and the skillful use of color in the sets, costumes and make-up.

In view of the difficulties of handling panchromatic film a good work was done on machine development and results that were of the finest quality and uniformity were obtained, solely by control of time and temperature.

Sound reproduction as influenced by emulsion characteristics and processing came in for plenty of attention, for it is highly desirable, for some methods, that the emulsion have an exceedingly fine and even grain structure and be free of fog, otherwise impurities in tonal value result, or in other words, film noise. A number of improved developing methods were worked out with excellent results. Studio acoustics and studio insulation against extraneous sound were studied in considerable detail and also the effects of frequency range and its influence on the rendition of the sibilants and some of the more difficult consonants.

The optical printer is such a useful tool in modern picture production and capable of so many applications that a special study was made of numerous new devices, optical and mechanical in order to extend its field of usefulness, a lot of very interesting combinations resulted. In these days there is quite a lot of 16-millimeter film enlarged to standard width so I did a lot of work on the optical conditions necessary to the elimination of enlarged grain effect and also made special emulsions suitable for duplicating.

Another interesting product was worked out, something a little apart from studio materials, but having its field of usefulness nevertheless; this being a fast bromide paper that can be coated without washing the emulsion during manufacture, which saves a lot of time and money. This emulsion can be coated right out of the mixing kettle, also it can be coated on cheap paper instead of expensive photographic raw stock without suffering any harmful effect, can be coated very thinly and still yield full vigor and quality and can be put through the hottest dryers without ill effect, is intended for motion picture stills for display and publicity purposes.

I realize all this is a very sketchy description of six months' really intensive work, but it may bring forth some suggestions for articles in THE AMERICAN CINEMATOGRAPHER wherein the subjects mentioned can be dealt with a detail; any little grains of experience or knowledge I have gleaned are very much at the disposal of the A. S. C.

ALFRED B. HITCHINS, F.R.P.S., F.C.S., F.R.M.S.

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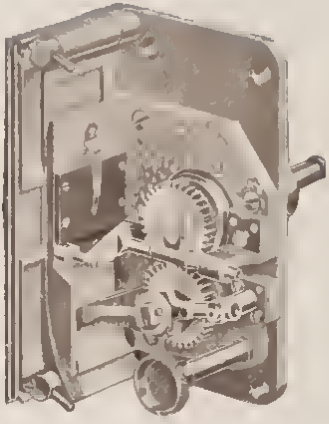
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